IMPLEMENTATION OF SCHOOL-BASED VISION CARE IN AN URBAN DISTRICT

by

Amanda Jean Inns

A dissertation submitted to Johns Hopkins University in conformity with the requirements for the degree of Doctor of Philosophy

Baltimore, Maryland

July 2018

Abstract

Far too many disadvantaged children have unmet needs for vision care. This has serious consequences for their lives, and may be a serious barrier to academic success. The purpose of the series of studies presented in this dissertation is to examine the effectiveness of the implementation of a school-based vision care model designed to ensure that all students needing glasses receive and wear them. The basic program, Vision for Baltimore, provides vision screening, assessment, and glasses (if needed) to all children in Baltimore City Schools in grades PK-8. The studies reported here build on this major randomized experiment. This was done in three linked efforts.

The first set of research questions and analyses focused on one component of the Vision for Baltimore project: the use of additional outside support and group incentives to increase parental consent rates and enhance students' participation in the program. Findings suggest that utilizing additional support staff in the form of School Vision Advocates (SVAs), as well as modest teacher group incentives, are each effective strategies to increase the number of parent permissions, increasing the number of students utilizing a school-based vision program.

The second set of research questions and analyses examined the impact of the Vision for Baltimore model of school-based vision care on glasses usage rates. The results of this study provide evidence that school-based vision programs can increase the number of students wearing glasses in schools.

The third and final set of research questions and analyses descriptively examined the replacement rates of glasses across schools. While the replacement process appears to be underutilized by schools, the reason for this pattern is unknown. The study also examines the role of school organizational health with glasses replacement and usage rates. Schools with high

levels of organizational health appeared more likely to develop higher levels of glasses wearing, and these schools also used the glasses replacement process for the benefit their students as needed.

Examining the implementation of school-based vision programs helps these programs to become effective and replicable ways of providing necessary vision services to numerous children.

Primary Reader: Nancy Madden

Secondary Reader: Robert Slavin

Acknowledgements

A great number of individuals have supported me over the past four years on my journey from educator to researcher. Dr. Nancy Madden has invested so much time helping me take this from an idea to an accomplishment through countless iterations while constantly pushing me to be better. Dr. Robert Slavin has provided invaluable mentoring and editing, without which I wouldn't have arrived at the destination. I am grateful that Drs. Madden and Slavin never let me forget that ultimately this work is about helping children, providing the motivation to forge ahead. I would like to thank the additional members of my dissertation committee, Dr. Martha MacIver, Dr. Jackie Nunn, and Dr. Megan Collins, for their feedback and insights throughout this process.

I would also like to recognize the large team of people from the Vision for Baltimore program that have contributed to this project. I am especially grateful for Christine SySantos Levy, Grace Galiani, Anne Currie, Dr. Betsy Wolf, Alyssa Kretz, Rani Mukherjee, Wade Brown, and the School Health team at the Baltimore City Health Department for their tireless efforts on behalf of children as well as for helping me in my quest to understand how a large-scale vision program works.

Thank you to my husband, Nick, for listening to my rants about glasses and providing unswerving support. I could not have accomplished this without your help.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Reading is a vital skill, key to success in school, necessary for getting and maintaining employment, and essential for functioning in everyday life. Yet students continue to leave school without basic literacy skills. According to the 2015 National Assessment of Educational Progress (NAEP), only 37% of students in twelfth grade scored at or above a proficient level in reading (National Center for Education Statistics, 2015). This problem is not unique to students about to exit the school system. The 2015 NAEP showed that only 34% of eighth grade students and 36% of fourth grade students scored at or above the bar defining proficiency (National Center for Education Statistics, 2015). These statistics are even more concerning for students from historically underserved populations; only 18% of African American students and 21% of Hispanic students are at or above proficient in fourth grade reading, and the rates stay approximately the same in eighth and twelfth grade (National Center for Education Statistics, 2015). The numbers of students lacking literacy skills is a national crisis and the disparities among ethnic groups is a source of many of our most important social problems.

There have been efforts to remedy this situation through policy initiatives such as the Comprehensive School Reform Demonstration and No Child Left Behind. Yet the performance of American students has not dramatically improved (McFarland et al., 2017). Our efforts to make all students competent readers have thus far failed many students.

Many attempts to solve this problem have focused on schools, including reform or instruction, yet "out of school" factors have a substantial impact on student learning (Clabaugh, 2008). These factors, such as blighted neighborhoods, reduced access to healthcare, and fewer opportunities for learning outside school, are often concentrated among students living in poverty (Berliner, 2009).

One non-school factor that is gaining traction as a potential explanation for school failure is inadequate vision. There is widespread need for glasses (Ferebee, 2004); however many students, especially students living in poverty, have both reduced access to vision services as well as higher rates of vision problems (Basch, 2011; Kemper, Cohn, & Dombkowski, 2004; Qiu, Wang, Singh, & Lin, 2014). This leads to a large proportion of the school-age population with uncorrected vision problems.

Even once students are provided with vision services and appropriate vision care, they need to wear their glasses regularly to benefit from them. A number of studies of different age groups, and at different follow-up points, have examined the use of glasses (compliance rate) among students provided glasses (Alvi et al., 2015; Ethan, Basch, Platt, Bogen, & Zybert, 2010; Kodjebacheva, Maliski, Yu, Oelrich, & Coleman, 2014; Messer et al., 2012; Preslan & Novak, 1998). The compliance rates vary widely, with three studies showing very low compliance of 30-47% and two studies having much more success with compliance, with between 73-86% of students wearing their glasses at follow-up (see Table 1). While two studies demonstrated higher compliance, they occurred in small studies with only 15 students (Kodjebacheva et al., 2014) or glasses compliance was measured through a survey completed by school nurses, through which nurses, teachers and even students could self-report glasses wearing, which was not verified by independent staff (Alvi et al., 2015). These examples show that it cannot be assumed that providing students with glasses means that they will wear them. This is a tremendous problem that demonstrates vision care is not enough; there must also be an ongoing effort to make sure that students are wearing their glasses regularly.

Unmet vision needs, prevalent among high-poverty populations, are particularly important to address because of the link between vision and learning. The connection between

adequate vision and academic success, especially in reading, is understood and accepted by all (Kodjebacheva, Maliski, & Coleman, 2015). Parents, teachers and school nurses agree that unmet vision needs can have a negative impact on school performance (Kodjebacheva et al., 2015). There is evidence supporting a relationship between wearing appropriate glasses and achievement in a variety of contexts (Dudovitz, Izadpanah, Chung, & Slusser, 2016; Esteso et al., 2007; Hannum & Zhang, 2012; Pavithra, Hamsa, & Madhukumar, 2014). In an experimental study in rural China that provides the strongest causal evidence, Ma et al. (2014) found that students given glasses at school scored significantly better on a math test than those who received a prescription for glasses or a voucher to purchase glasses. During a pilot study of school-based vision care to elementary students in Baltimore (Slavin et al., in press), students who needed glasses (using liberal prescribing criteria) and received them significantly improved their reading scores when compared with students who never needed glasses (ES = +0.16). If students are to succeed in school, they need to be able to see.

While school-based vision programs as a way to give students access to glasses is a growing trend, there has been limited research on these programs, particularly in the United States. The only rigorous, experimental work examining the efficacy of these programs has taken place in China (Congdon et al., 2011; Ma et al., 2015, 2014; Yi et al., 2015; Zeng et al., 2009). Additionally, there is little research on strategies for insuring that students retain and use their glasses properly. It seems natural that school-based programs would take advantage of existing school structures and procedures to support student glasses use. Yet very few programs make any attempt to engage schools. Beyond giving students glasses, an ongoing process is needed to ensure that students wear them consistently, care for them, and replace them if they are lost or

broken. It is essential to understand how much support is needed to ensure that glasses are not only provided but also worn regularly by students.

This study is part of a larger project called Vision for Baltimore that seeks to increase our understanding and support for effective practices that provide students with needed vision care as well as the ongoing strategies to ensure the regular and ongoing use of glasses. The project is unique in two ways. First, the project uses a rigorous cluster-randomized design to examine the impacts of a school-based vision program on academic achievement, the first experimental study of these programs in the United States. Second, the project model includes enhanced, ongoing services in schools to ensure that students not only receive glasses, but also that schools develop a culture of glasses-wearing and provide strategies for addressing loss and breakage of glasses, to support increased levels of compliance with glasses prescriptions.

The purpose of the series of studies presented in this dissertation is to examine the effectiveness of the implementation of a school-based vision care model designed to ensure that all students needing glasses receive and wear them. This was be done in three linked efforts.

The first set of research questions and analyses focused on one component of the Vision for Baltimore project: the use of additional outside support and group incentives to increase parental consent rates and enhance school participation in the program. It was expected that both additional outside support and group incentives would increase the number of students who receive parent permission to receive assessment and, if needed, glasses.

The second set of research questions and analyses examined the impact of the Vision for Baltimore model of school-based vision care on glasses usage rates. It was expected that participation in Vision for Baltimore would increase the number of students wearing glasses

during follow-up observations. The role of fidelity of implementation on this relationship was also be examined.

The third and final set of research questions and analyses descriptively examined the replacement rates of glasses across schools. Then the correlation between schools' organizational health and replacement rates was explored. Schools with greater levels of organizational health were expected to have higher rates of glasses replacements and retention.

In what follows, an overview of the proposed thesis is presented. A general literature review and overview of the Vision for Baltimore project is given in Chapter 2. A discussion of the method, data analysis, and results for each of the different sets of research questions is given in Chapters 3-5, which are presented as three free-standing papers. Chapter 6 summarizes learnings across the three papers, and discusses the meaning of the findings for policy and practice.

Chapter 2: Background Information

Introduction

As elaborated in Chapter 1, children in the United States have a very high rate of uncorrected vision disorders, which may result in lower academic achievement. This series of studies examined the effectiveness of implementation of a specific model of school-based vision services. Before describing the methodologies of the three studies reported in Chapters 3-5, this chapter reviews the background literature relevant to all. The Vision for Baltimore program is also described in detail, as the context for the studies.

Childhood Eye Disorders & Prevalence

Visual deficits are a relatively common problem across the United States, with more than 20% of children experiencing a vision problem (Ferebee, 2004). The bulk of these disorders are related to refractive errors, including myopia, hyperopia, and astigmatism (Ruderman, 2016). Myopia, or nearsightedness, is a condition in which distant objects are poorly seen. Hyperopia, or farsightedness, is a condition in which near objects are poorly seen. Astigmatism is a condition in which the cornea or lens is misshapen, which leads to poor vision at all distances. Data from the Multi-Ethnic Pediatric Eye Disease Study and the Baltimore Eye Disease Study (Borchert et al., 2011) and the Collaborative Longitudinal Evaluation of Ethnicity and Refractive Error (CLEERE) study (Kleinstein et al., 2003) provide information on prevalence of each of these disorders (see Figure 1). Among preschool students, most students are hyperopic (21%), with a small number of students exhibiting myopia (4%) (Borchert et al., 2011). The proportions shift for school age students in grades one through eight, with more students diagnosed with myopia (9.2%) and a lower rate of hyperopia (12.8%) (Kleinstein et al., 2003).

Overall, across these age groups, approximately one-fifth of students have a correctible refractive error disorder. Clearly there is substantial need for eye care across the United States.

While vision disorders in children are relatively common, the rates vary as a function of race/ethnicity (Basch, 2011; Borchert et al., 2011; Huang et al., 2014; Kleinstein et al., 2003; McKean-Cowdin et al., 2011; Multi-Ethnic Pediatric Eye Disease Study (MEPEDS) Group, 2009; Ying et al., 2014). While the differences between groups depend greatly on the age of the children and the diagnosing criteria, a few general trends can be seen in the literature. For example, white and Hispanic students are more likely to be hyperopic (Borchert et al., 2011; Kleinstein et al., 2003). African American and Hispanic children are more likely to be identified as astigmatic (Huang et al., 2014; McKean-Cowdin et al., 2011). These racial and ethnic differences could be explained by genetic causes; refractive error has a large genetic component (Stambolian, 2013; Young, 2007), so that among certain groups it will tend to be inherited and become more common than in other groups.

Visual impairment also varies as a function of socioeconomic status (Basch, 2011; Ethan et al., 2010). There appears to be higher rates of certain vision disorders among lower socioeconomic status communities (Ethan et al., 2010; Majeed, Williams, Northstone, & Ben-Shlomo, 2008). Studies of students from low income urban areas found rates of vision problems more than twice the normal rate, with failure rates on screening nearing 50% (Gould & Gould, 2003). It is not entirely clear why there are higher levels of vision impairment among impoverished students. One explanation is that there are environmental or other factors associated with poverty that could lead to higher levels of vision impairment. For example, factors such as smoking while pregnant (Borchert et al., 2011; Cotter et al., 2011; McKean-Cowdin et al., 2011; Tarczy-Hornoch et al., 2011) and not breastfeeding (Tarczy-Hornoch et al.,

2011) are associated with increased risk of vision disorders and are also associated with poverty. This explanation could lead to an increase in the prevalence of vision disorders in disadvantaged children. Another possible explanation is that children living in poverty have reduced access to vision care, which can lead to increased visual impairment in two ways. First, these students do not receive early vision care which can address vision disorders that prevent later problems from developing. For example, one risk factor for more serious vision disorders is uncorrected refractive error (Cotter et al., 2011; Hussein, Weakley, Wirazka, & Paysse, 2015), so that by having reduced access to vision services at a young age, the prevalence rate of later disorders is increased. Second, students with less access to vision care have less opportunity to receive glasses, so that they are more likely to fail screenings, which are always conducted with students wearing whatever glasses the students may have. For this reason, the increased failure rate for impoverished students may not reflect a difference in prevalence but rather a difference in access to vision services and glasses. While the exact reasons for the disparities in vision impairment among students living in poverty and specific ethnic groups are not well understood, it is clear that there is an increased need among students living in poverty that is alarming and suggests that additional attention must be paid to serving these children.

Identification & Treatment

The first step to addressing the issue of vision disorders is identifying the students who need vision services. This is key because most refractive error disorders can be treated with glasses alone (Dobson, Clifford-Donaldson, Green, Miller, & Harvey, 2009; Harvey, Dobson, Clifford-Donaldson, & Miller, 2007; Wallace et al., 2007). Although there can be lifelong consequences to untreated vision needs, appropriate care can address many of the vision disorders existing in children. Long-term consequences of lack of needed vision care can include

permanent vision deficits (Hussein et al., 2015), negative impacts on learning (Thurston, 2014; Williams, 2005), and consequences in adulthood such as reduced quality of life (Davidson & Quinn, 2011). These adverse effects can be avoided if children are identified and receive vision care.

There are three main strategies for identifying children with vision disorders: school-based screenings, community- or office-based screenings, and comprehensive eye exams (Ferebee, 2004). School-based screenings can be an effective way to identify students with potential vision problems (Bailey, 1998; Bodack, Chung, & Krumholtz, 2010). Students can be screened in schools effectively by nurses (Clarke et al., 2008; Gallaway, 2010; Strawhacker, Gustafson, Kinne, & Little, 2003; Yawn, Lydick, Epstein, & Jacobsen, 1996) and trained non-medical staff (Krumholtz, 2004). Technology, such as the use of an auto-refractor (Clarke et al., 2008) or computer software (Gallaway, 2010) can improve the precision of the screening. In order to identify students who may require vision care, school-based screenings are an effective and realistic solution.

While school-based screenings are a feasible way to identify students with potential vision disorders at scale, their use is far from universal. Only 40 states require screening of school-age children and only 15 states require that preschool students complete a vision screening (Ruderman, 2016). Students are also usually not screened every year, so that even in states with mandated screenings, students may go years before being identified. For example, in Maryland, mandated screenings occur only at school entry, first grade, and eighth grade. In Illinois it is at school entry, second grade, and eighth grade. According to the National Survey of Children's Health, 32% of students have not been screened in the prior two years (n.d.). This increases for Hispanic students (43%) and students living below the federal poverty level (42%)

(National Survey of Children's Health, n.d.). There is no accepted standard for which students should be screened, how often, by whom, and which specific tests and cutoffs should be used (Ciner et al., 1999). The lack of a universal mandate for frequent school-based screening means many students are not being flagged as potentially having a vision disorder in need of additional services, so they do not even start down the path to receiving the needed care.

Access to Follow-Up

Once students are identified with a potential vision problem, they are normally referred to a vision professional for a comprehensive exam and treatment (Kodjebacheva et al., 2015). However, students often do not receive adequate follow-up after a failed vision screening (Clarke et al., 2008; Mark & Mark, 1999; Neville, Radii, & Velmer, 2015). There have been several studies examining poor adherence rates to vision screening recommendations that are summarized in Table 2. The rates vary substantially, with low rates of successful adherence to the screening failure recommendations of 17% (Clarke et al., 2008; Neville et al., 2015) to more successful referral programs, where approximately two-thirds (Mark & Mark, 1999) had parents follow through on screening recommendations. While each of these studies took place in urban settings, only one had predominantly low-income populations (Clarke et al., 2008). Even when most parents did access follow-up care after a failed vision screening, that follow-up exam was up to two years after the failed screening (Yawn et al., 1996). School-based screenings, while effective at identifying students who may have vision disorders, do not result in timely access to care for most students.

This lack of follow-up to failed vision screenings has important consequences. Many students who require vision care and glasses do not receive them (Bodack et al., 2010). Approximately 9% of children aged 12-19 have inadequate correction for refractive error (Qiu et

al., 2014; Vitale, Cotch, & Sperduto, 2006). This means that they either do not have any glasses when they need them (uncorrected refractive error) or they have glasses that are the wrong prescription (undercorrected refractive error). Even more significantly, one fourth of children with poor vision that could be improved with glasses don't have them (Qiu et al., 2014).

The reality is even worse for Mexican American and African American children, who are less likely to have adequate correction than White children (Qiu et al., 2014). Students of color including African American, Hispanic, and multiracial children are more likely to have unmet vision needs (Heslin, Casey, Shaheen, Cardenas, & Baker, 2006). The same patterns hold for students from low socioeconomic backgrounds (Heslin et al., 2006). Hispanic and non-white children are also less likely to have a vision disorder diagnosed (Ganz, Xuan, & Hunter, 2007). Lack of access to vision care after failed screenings results in students who do not have the vision care and glasses they need.

There are many barriers that prevent disadvantaged parents from following through on a recommendation to see a vision professional after a failed vision screening. These barriers fall into three main categories: logistic, financial, and attitudes and beliefs (see Figure 2).

The location of the eye care providers can cause difficulty for many parents, because they may not be located in their community and could require transportation that may be inconvenient or unavailable (Kodjebacheva et al., 2015; Pizzi et al., 2015). The time needed to get to these appointments, both for the appointments themselves as well as for travelling to and from the exam, is difficult for many parents to find (Kodjebacheva et al., 2015; Mark & Mark, 1999). Scheduling the appointment at a feasible time can be challenging (Pizzi et al., 2015), especially when all adults in a family work (Kimel, 2006), and parents may have to wait months for an appointment (Yawn, Kurland, Butterfield, & Johnson, 1998).

Another set of barriers often reported by parents are financial. The cost of exams, eye glasses, transportation, and loss of wages while taking the child to the exams are frequently given as the reason parents do not follow-up on failed vision screenings (Kimel, 2006; Kodjebacheva et al., 2015; Mark & Mark, 1999; Yawn et al., 1998). These barriers are particularly burdensome for people with low socioeconomic status, who are even less likely to be able to afford vision care (Zhang et al., 2012).

The final set of barriers preventing parents from following through with failed screening recommendations are related to attitudes and beliefs. Some parents reported not prioritizing vision care (Kimel, 2006; Pizzi et al., 2015) and even not believing the results of the screening (Kimel, 2006; Yawn et al., 1998). There were also parents who claimed they were not aware of the issue or believed there was no need to follow-up on the failed screening (Kimel, 2006; Pizzi et al., 2015). Some of this may be related to parents not receiving the screening failure notification letter (Mark & Mark, 1999; Yawn et al., 1998), but that does not explain all of the parents who do not follow through with failed vision screening recommendations. Additionally there are parents who do not take their children for vision care because they have already done so and the child refuses to wear the glasses, so they believe there is no need to repeat the process (Mark & Mark, 1999). These attitudes and beliefs about vision and screenings by parents prevent them from accessing vision care for their children.

These barriers to getting students appropriate care after a failed vision screening are not insurmountable. There are strategies that can improve the follow-up rate on vision screening and overcome many of the identified barriers. Lin et al. (2012) improved follow-up adherence rates after sending parents reminder text messages about follow-up care. Assigning school nurses to call parents to discuss the screening results and need for follow-up exams increased the number

of children receiving vision care (Clarke et al., 2008; Neville et al., 2015). Each of these interventions was able to positively impact follow-up rates after failed vision screenings, but still left many students without the vision care they need.

School-Based Care

An alternative approach to solving the vision care gap is school-based vision care. In these models, students who have failed a screening receive follow-up care and glasses onsite at the school. Such approaches are growing in popularity and include programs such as ChildSight (part of the Helen Keller Foundation), Vision To Learn, and OneSight. In many ways, school-based programs are a logical solution. Students spend many waking hours in school with adults who know them and their needs. They are in known locations for specified periods of time and could be reliably found for follow-up care. School-based vision services can overcome many of the logistic and financial barriers to vision care reported by parents. Schools are also situated to provide education and awareness to parents to overcome attitudes and beliefs that prevent students from receiving adequate vision care. Parents are likely to know and trust their own children's teachers, especially in elementary school, so school-based care builds on a foundation of trust. Instead of asking parents to go to a place they do not know to get services from people they do not know, and who do not know them or their child, parents are more like to cooperate with people in their child's school. While there are small numbers of students who have more serious vision deficits that cannot be solved with glasses and instead require special treatment, schools can assist with making the referrals connecting parents to the appropriate care.

Logistic challenges to school-based care. Even as school-based programs provide the promise of equitable access to vision care for all, there are logistical challenges.

Consent return. The most significant challenge of school-based care is that of documenting parental consent for vision care. Providing vision care to students at school requires parental consent for program participation. This may be provided as passive consent, where parents receive a form about program participation and return the form only if they wish to opt out of the program. However, the more common approach requires active consent, where a permission form is sent home and it must be signed by the parent and returned in order for the student to participate in the program. Collecting these can be difficult, and low return rates decrease the reach and impact of the program. This was a specific challenge in the Vision for Baltimore program and is discussed in greater detail in Chapter 3.

Long-term challenges. School-based vision programs may effectively provide students access to vision exams and glasses, but there are other long-term goals that must be considered. Students must wear their glasses as prescribed for improved vision. This results in two main concerns: student compliance with wearing their glasses and students retaining their glasses and replacing lost or broken glasses as needed. Challenges with compliance (students wearing glasses they receive) are discussed in greater detail in Chapter 4. Difficulties with students' needs for glasses replacements are examined in Chapter 5.

Overview of the Vision for Baltimore Project

Vision for Baltimore is a project seeking to provide school-based vision care to students in the Baltimore City Public Schools. Over three years beginning in fall 2016, all public school students in preschool through eighth grade will be served by the program. All students participate in vision screenings. These screenings identify students who may have vision deficits and require further follow-up. These identified students are invited to receive a follow-up eye exam from the program at their school. Exams are provided by licensed eye care professionals in

a mobile clinic. Students who require prescription glasses select frames at the time of the exam. Glasses are dispensed at the school about two weeks after the exam. The project has multiple partners, including the Baltimore City Health Department (provider of screening services), Vision To Learn (provider of the mobile van), Warby Parker (provider of prescribed glasses), Baltimore City Public Schools, and Johns Hopkins University (provider of support systems for ensuring high participation rates).

The process has multiple stages, as shown in Figure 3. Students receive a screening at school to identify those who may have vision deficits, followed by school-based exams and glasses for students who need them. The entire process is completed at the students' schools.

The first step begins with the Baltimore City Health Department providing initial vision screenings to students at schools. Students receive notification of the screenings in advance and are given the option to opt out of the vision screening. There are three possible outcomes of the screening stage: pass, fail, missed. Students may be missed because they are absent on the day of the screening or missed their school's screening date because they have transferred to another school. Students who fail these screenings are sent a notification of failure including an invitation to participate in the project and receive school-based vision services.

The next stage of the process is return of the consent form to participate in the program. All students who fail the screening receive a consent form through the school to take home and give to their parents to sign. There are again three possible outcomes of the consent form stage: consent to service, refusal of service, and parental non-response. Parents may refuse service for a variety of reasons, including that their child already receives vision care outside the school or distrust of the program. Parental refusal is rare. More common is parental non-response, which may be related to parents not receiving the form or understanding the importance of vision care.

Students whose parents choose to receive vision services are scheduled to receive a full eye exam in Vision To Learn's mobile eye clinic when it visits their school. The outcomes of these exams are several. Students may be examined and found to need glasses, which are prescribed. Students may be examined and found to need additional follow-up care and are referred to other providers in the city. Students may also be examined and determined to have normal vision, not requiring glasses. Finally, students may not be examined by Vision To Learn during their visit to the school. This may be due to student absence or unwillingness for the student to be removed from class.

At the next stage of the program, glasses are ordered for students who need them. Students who are determined to need glasses are prescribed glasses and choose glasses frames, on the day of the exam, from among models provided by Warby Parker in the mobile eye clinic with an optician. The glasses are dispensed and fit for students at their schools approximately two weeks after the exam.

If glasses are lost or broken within one year, replacement glasses are provided by Vision for Baltimore.

Johns Hopkins University provides implementation support services through School Vision Advocates (SVAs), who assist with the logistics of these screenings, exams, and dispensing visits, as well as provide education and monitoring support to schools to ensure that students are wearing their glasses. The level of these support services depends on the capacity of the School Vision Advocates, the level of support required by schools, as well as schools' willingness to work with the School Vision Advocates on education and monitoring, such as through providing time during faculty professional development and allocating resources for the monitoring plan.

The Vision for Baltimore model is a truly comprehensive approach to school-based vision care, and as such provides more services and support, including the ongoing engagement with schools, than many other school-based vision programs.

Vision for Baltimore: Research Study

In addition to providing students school-based vision care, there is a research component to the Vision for Baltimore project. Researchers at Johns Hopkins University are conducting a rigorous evaluation to assess the impact of school-based vision care on reading and math achievement. This evaluation uses a cluster randomized design, with schools randomly assigned to one of three cohorts, each receiving services in a different year of the project (see Figure 4). This impact analysis will focus on the impact of school-based vision services on student achievement as measured by state test scores, as well as contributing data on the rates of glasses use across cohorts.

Randomization was conducted in the summer of 2016, prior to the start of the school year. Block randomization was used to increase the statistical power. Schools were organized into blocks according to proportion of male students, proportion African American, Hispanic, and Asian, percent of school scoring at or below level one on the state standardized test, proportion of students receiving special education services, school type (elementary, elementary/middle, and middle), charter status, and pilot school status. Once the blocks were created, schools were randomly assigned within blocks to one of three groups, corresponding to the years in which they would first receive vision services: SY 16-17, SY 17-18, or SY 18-19. There were a total of 127 schools that were randomized for the Vision for Baltimore research study (see Table 3). Of these schools, most were elementary/middle (56%) or elementary (37%) schools, with a small number of middle schools (7%). Nearly a fifth were charter schools (20%).

The schools had a mean enrollment of 445 students. The schools' mean enrollment was 51% male. The schools' populations were mostly African American (83%), with White (9%) and Hispanic (6%) making up the largest remaining student groups. The schools are also mainly low performing, with large numbers of students not meeting expectations on the PARCC test in either English language arts (85%) or math (90%). The schools also have very high levels of poverty, with 88% of students that qualify for free and reduced meals.

Schools were randomly assigned as described previously. There were 42 schools assigned to the first cohort (SY 16-17), 42 schools assigned to the second cohort (SY 17-18), and 43 schools assigned to the third cohort (SY 18-19). As can be seen in Table 3, the randomization was successful in creating comparable groups in terms of school features, demographics, and prior achievement. There were no statistically significant differences between the cohorts, demonstrating baseline equivalence on observable factors.

While the research component will provide evidence of the impact of school-based vision services on academic achievement, this project can also contribute to the literature about the implementation of school-based vision services. Studying implementation alongside the impact of these programs is important because the ultimate goal is to find replicable, scalable interventions that improve outcomes for students. Simply finding effective programs is not enough; we need to understand how to reliably implement those programs across a wide range of schools. Addressing that need and understanding outcomes for children is the goal of this series of studies.

Theoretical Framework

For this series of studies, Pettigrew and Whipp's Dimensions of Strategic Change is used as a theoretical framework (1992). As shown in Figure 5, in this model, strategic change is a

function of the interaction of three separate dimensions: Content, Process, and Context. Successful organizational change, such as effectively using a new intervention within a school, requires that all three dimensions work together to support the necessary change.

Content. Content refers to the "What" of the change, meaning the specific goals and activities that are being introduced. For this specific series of studies, the content is well-defined, as the Vision for Baltimore model of school-based vision care. Specific information about the content of this series of studies, school-based vision care, was previously discussed.

Process. Process defines the "How" of the change, including all strategies to support implementation of the content. Over forty years ago, Berman and McLaughlin identified implementation as "the bridge between a promising idea and its impact on students" (1976, p. 349) and how well an idea is enacted remains an integral part of how successful that change attempt will be. Individual studies have shown that better implementation results in better outcomes than poor implementation (Lambert, Gallagher, & Abbott-Shim, 2015; Porowski & Passa, 2011). These patterns have been replicated in systematic reviews, both of prevention and health programs for children (Durlak & Dupre, 2008), as well as in K-12 curricular interventions (O'Donnell, 2008). Few would debate the importance of paying attention to how an intervention was implemented.

Context. The final dimension of the model is the context, or the "Where" of the change. This includes both the internal environment of the organization implementing a change as well as the external economic, political, and social environment. This organizational approach to implementation is logical and helpful, particularly for complex interventions. Because many interventions require a collective effort within an organization to implement successfully, an organizational lens is appropriate (Weiner, Lewis, & Linnan, 2009). In their study of workplace

health promotion, Weiner, Lewis and Linnan (2009) identified a theory of how organizational components relate to implementation, including the organizational readiness for change, the implementation policies and practices of the organization, the climate, and the fit between the intervention and the organization. Their theory explains how the components are related to one another and help determine the effectiveness of implementation, which in turn determines the effectiveness of the intervention.

The first study examined how two additional implementation strategies help achieve the project goals (content). The second study examined the effectiveness of the program (to what degree were the content objectives achieved) and how that success was related to the process of how program was implemented. The third and final study explored the relationship between one specific component of the content (glasses replacement) and how use of that component was related to the organizational context of the schools. While each study examined different aspects of these dimensions needed for successful change, together they cover the complete model.

Chapter 3: The Use of Advocates and Group Incentives to Increase Vision Examination Consent Return Rates in School-Based Vision Care

Introduction & Literature Review

There is a substantial need for eye care in children, with approximately one out of every five students having refractive error requiring glasses (Ferebee, 2004). Despite the correctable nature of refractive error (Vitale et al., 2006), many children continue to suffer from visual impairment in schools (Qiu et al., 2014). The problem of unmet vision needs is especially acute among students from low-income backgrounds and for students of color (Basch, 2011; Kemper et al., 2004).

School-based delivery of eye care has grown in the past decade as a way to reduce the number of students with untreated visual impairment (Ethan & Basch, 2008). As opposed to traditional vision screening programs for school-age children, which often do not result in high numbers of comprehensive eye exams for children (Kodjebacheva et al., 2015), school-based vision programs bring the entire process directly to schools, from initial screening to eye exams, fitting glasses, and replacing lost or broken glasses. These programs aim to address the multitude of barriers to follow-up after a failed vision screening (Kimel, 2006; Kodjebacheva et al., 2015; Mark & Mark, 1999; Preslan & Novak, 1998; Su et al., 2013). Ensuring that students have access to vision care is especially important when considering the link between vision and academic success. Evidence supporting this connection is widespread (Dudovitz et al., 2016; Esteso et al., 2007; Hannum & Zhang, 2012; Pavithra et al., 2014), with one experimental study in China reporting that students who were given glasses at school scored significantly better on a math test than those who received only a glasses prescription or a voucher to purchase glasses (Ma et al., 2014) and another showing improvements in reading for Baltimore City students who needed

and were given glasses, according to liberal prescribing criteria, in comparison to those who never needed glasses (Slavin et al., in press).

Yet school-based delivery of vision care will not adequately meet eye care needs if students are not participating in these programs. Providing vision care to students typically requires active parental consent for program participation, and obtaining consent can be difficult. In one large urban California district with high levels of poverty (Chu, Huang, Barnhardt, & Chen, 2015), students who failed their school vision screening received a letter discussing the need for a vision exam, as well as a consent form for a free exam and glasses. Only 51.8% of the consent forms were returned, leaving almost half of the students without the vision care they needed. In this situation, school-based care was only minimally better than the traditional model where students seek eye exams after receiving a referral letter from a failed vision screening (Chu et al., 2015). Other forms of school-based care, such as oral health and vaccination programs, have reported similarly low consent rates (Carpenter et al., 2007; Dudovitz et al., 2018).

Collecting active parental consent in school-based programs has frequently been cited as a challenge (Ellickson & Hawes, 1989). While opt-out consent has shown higher response rates in school programs, this method of obtaining permission has disadvantages, including decreased parental engagement and lack of confirmation of informed consent (Hollmann & McNamara, 1999). Also, policy barriers often make opt-out consent impossible. Thus, it is necessary to explore methods of increasing active parental consent in schools.

Prior research has shown multiple strategies that successfully increase parents' response rates with active consent. Typically, a combination of methods is used, including attaching consent forms to other mandatory school forms and providing incentives to teachers and students

(Esbensen, Melde, Taylor, & Peterson, 2008). Class incentives (Ji et al., 2006), reminders (Mak, Bulsara, Goggin, & Effler, 2011), and increased staff support (Ji, Pokorny, & Jason, 2004) have all shown a positive impact on consent return rates. However, only a few studies have tested differences between these different recruitment strategies. Unti, Coyle, Woodruff, and Boyer-Chuanroong (1997) examined the addition of peer incentives to individual incentives. Leakey, Lunde, Koga, and Glanz (2004) explored differences in consent rates for different combinations of levels of support, reminders, and incentives.

No studies to date have reported quantitative data examining the effect of using teacher incentives and increased staff support on consent rates in school-based vision programs. Here we examine participation in one model of school-based vision care that is currently being conducted in Baltimore. The overall approach involves phasing in screening, assessment, and glasses for students who need them for all students in grades prekindergarten to eight, over a 3-year period. After the first two months of program implementation in fall 2016, twenty-four schools had completed at least one round of vision screening. However, the parental consent rates at these schools were quite low (Figure 6). In this early implementation phase, only 26% of parents at these schools had returned forms to provide active consent for program participation (see Table 4). This was a positively skewed distribution, with 5 schools that had no consent forms returned. These consent rates were not significantly correlated with school demographics or characteristics such as size, proportion poverty (as measured by percent of students qualifying for free and reduced lunch), or race/ethnicity (Table 5). The return rate also did not significantly differ between charter and non-charter schools (Table 6) or elementary, middle, and elementary/middle Schools (Table 7). This limited participation was not easily explained by any obvious factor about the schools and was of immediate concern to the project.

The project took two different approaches to increasing consent return rates: increased outside support in the form of School Vision Advocates (SVAs), and group incentives for teachers. SVAs were intended to build relationships with the schools, identify stakeholders, ensure that all staff were aware of the project and the importance of consent return, and suggest ways to increase consent returns. These were all strategies that have previously been used to increase consent rate return (Blom-Hoffman et al., 2009; Fletcher & Hunter, 2003; Ji et al., 2004; Wolfenden, Kypri, Freund, & Hodder, 2009). Using incentives for teachers in a group contingency has also been effective to increase consent rate returns (Blom-Hoffman et al., 2009; Wolfenden et al., 2009).

Method

Purpose Statement

The purpose of the current study was to examine the effects of providing additional staff (School Vision Advocates or SVAs) to support schools in communicating to parents and in managing the consent return process, and then providing teacher group incentives based on the consent return rate in schools participating in the Vision for Baltimore program.

Theoretical Framework

The larger theoretical framework guiding this series of studies comes from Pettigrew and Whipp's Dimensions of Strategic Change (1992). This emphasizes the role of content (what you are hoping to introduce or change), process (how you are enacting the change), and context (where the change is taking place) in how successfully an organization is able to incorporate a new behavior or intervention (see Figure 5). This particular study focused specifically on the process dimension, implementation strategies to improve the process of how parents are invited to consent to have their children participate in the Vision for Baltimore program.

Within that larger model, this study approached the process of how to increase participation guided by the work of Blom-Hoffman and colleagues (2009), who reviewed the literature on how active consent can be increased in research studies. Their model of how to increase communication and improve parental response rates relied on forming partnerships with school staff and included multiple strategies, such as establishing need, identifying stakeholders, finding reliable communications, meeting to explain the project, creating reminders, and planning group incentives. This framework reflects the two implementation strategies examined in this study: SVA support, which covered five of the components, and the teacher incentive, which was the sixth component.

Program Description

The program examined seeks to provide school-based vision care in Baltimore public schools. Figure 3 presents an overview of the program. Over three years, all students in preschool through eighth grade will be served by the program. All students will receive vision screenings by Baltimore City Health Department staff. These screenings identify students who may have vision deficits and require further follow-up. Students who fail the screening are invited to participate in the project by receiving a service consent form to receive a follow-up exam at their school. Exams are provided by licensed optometrists in a mobile clinic. Students who require prescription glasses select frames at the time of the exam. Glasses are ordered and dispensed at the school. This study focused on the stage after screening when students and their parents are informed of the need for an exam and invited to return the consent form in order to participate in the school-based exam service. The specific process of obtaining consent forms is described in detail below in the experimental procedures.

Research Questions

Research Question 1: What is the effect of additional support staff (SVAs) on the consent return rate?

Because consent rate return is one of the major barriers to increasing the participation in this school-based vision program, additional support staff in the form of School Vision Advocates attempted to work with schools to increase their response rates. A total of three SVAs worked with all schools participating in the project, with each SVA taking primary responsibility for approximately 16 schools each year. This additional outside support was expected to increase the capacity of schools to engage parents and collect more consent forms.

Research Question 2: What is the effect of adding a teacher group incentive to the availability of support staff (SVAs) on the consent return rate?

As an additional strategy for increasing consent form return, a small teacher group incentive (school supplies valued at $20 per teacher) was added to the SVA support. The group incentive was earned if a school as a whole had an 80% consent form return rate, requiring the participation of all teachers in a school. It was expected that the incentive would motivate teachers to engage with parents and track down consent forms if there was a reward for their success. The use of the group incentive was expected to generate excitement and engagement among teachers so that teachers would encourage one another to increase their efforts in order for all to be successful.

Participants

This study was conducted as part of a multi-year, cluster-randomized evaluation of the Vision for Baltimore project. Schools were originally randomized to three cohorts, with each cohort receiving vision services in a different year. This study examined on attempts to increase consent form return during the first year of the project and thus focused on schools receiving

services in the first year of the project. Of all the schools receiving school-based vision services in this first year, a subset of schools was selected to examine the impact of SVA support and teacher group incentives. These schools had not yet completed the screening and exam process as of January, 2017, and were either elementary or elementary/middle schools, resulting in a sample of thirteen schools (Table 8). Charter schools and middle schools were excluded.

Of the thirteen schools, eight schools served students in prekindergarten through fifth grades, and five schools had grades prekindergarten through eight. These thirteen schools differed from the twenty-eight other participating schools in terms of charter status and school structure, with only the excluded schools having charter schools and middle schools. The included schools also had a higher proportion of elementary schools and lower proportion of elementary/middle schools than the full sample. In all other respects, the included schools were not significantly different from the excluded schools in terms of demographics, prior achievement, or size (Table 8).

Response Definitions and Measurement

The targeted outcome was the return of signed consent forms to participate in the vision program by parents of students who had failed the vision screening. The Baltimore City Health Department collected and processed the consent forms and maintained records of how many signed forms had been returned. The number of students who failed the vision screening and were given a consent form as well as the number of consent forms returned at each school was recorded and shared weekly among project partners. The SVAs tracked their visits to schools, as well as the date incentives were introduced at each school. These weekly Health Department records and SVA calendars provide the data for this study.

Experimental Design

A non-concurrent multiple baseline design (Watson & Workman, 1981) was applied in the present study. This means that after measuring a dependent variable to establish a baseline, an intervention was introduced, but the timing of the intervention differed across subjects. The start of each period varied across schools, as determined by scheduling of the screenings and SVA support. In this study, there were three periods of data collection: baseline, SVA support, and SVA support + teacher incentives. The research design is illustrated in Figure 7.

A non-concurrent multiple baseline design is one type of single-subject design considered experimental in that it is able to demonstrate causal links between two variables (Horner et al., 2005). When these designs are rigorously implemented, each subject serves as his or her own control, so that any difference in the outcome can be considered the result of the treatment. Often, as in the present study, the "single subject" is a group, such as a school or classroom. The use of single-subject experiments such as non-concurrent multiple baseline designs are common and appropriate in psychology and education (Alnahdi, 2015) and are especially useful for practitioners in applied settings (Lanovaz & Rapp, 2016).

Experimental Procedures

Baseline. At the first step of the V4B program, all students are screened for possible vision deficits. This is done in two stages: mandated and non-mandated screenings. Maryland law requires that all students in grades prekindergarten, first, and eighth, as well as new entries to the school, are screened for both hearing and vision. Those students were all screened in the first visit to a school. Schools were given service consent forms with the names of students who failed the vision portion of the screening, to send home to parents via their children. These forms needed to be signed and returned in order to receive the vision exam at school. The school health suite received a list of all students who had failed the screening and the school was told to collect

the consent forms. The number of forms collected during this period produced our baseline consent rate.

The second stage of the screening process was to screen all remaining students who had not been seen in the mandated period. This included grades two through seven, as well as kindergartners who were not new to the school. These students were screened in the second visit to the school, which took place between one and eight weeks after the first visit. Schools again received labeled service consent forms to send home to parents and the school nurse received a list of all students who failed.

SVA support. School Vision Advocates (SVA) from the V4B program provided additional support to schools. This included creating class lists of screening failures and distributing them to school staff and teachers, encouraging school staff to notify parents about the forms through phone calls, newsletters, and emails. The SVAs visited schools 2-4 times a week to monitor progress in collecting consent forms. They assisted schools in resending consent forms to parents who had not yet responded, often making new copies to distribute to each teacher. In addition, they provided a script for office staff to make school-wide intercom announcements about returning forms.

SVA support + teacher incentives. After the non-mandated screening, schools were scheduled for their mobile vision exams, the third step in the V4B process. To maximize student participation, schools were offered an incentive to increase their parental response rate. Schools were told that if they could increase the number of responses to 80%, each teacher would receive requested school supplies valued at $20. They were given one week to achieve the 80% response rate. Schools were regularly given lists of students who needed to return forms organized by

homeroom, as well as labelled consent forms. SVAs encouraged schools to create their own plans for increasing the response rate, which included strategies such as student incentives.

Data Analysis

The impact of SVA support and teacher group incentives on consent rate return was examined using a visual inspection of the data. This approach to analysis is commonly applied to single case designs with multiple data points (Huitema, 2011; What Works Clearinghouse, 2017). The logic of this analytic strategy is to plot the consent rate at each measurement point (in this case weekly). The point at which the intervention is introduced is also marked on the graph. The difference between the level and slope of the line before and after the intervention is implemented shows whether a treatment effect exists.

To improve the internal validity, at least 3 observations of the weekly consent rate in each of the three phases was collected (Christ, 2007). This allowed the consent rate in each of the phases to stabilize such that the consent rate was predictive of what it would be in the absence of treatment. Therefore, any difference was more likely due to the intervention rather than to any other explanation.

Results

Data for each school are graphed in Figure 8, Figure 9, and Figure 10. Due to scheduling and data collection outside of the researchers' control, not all schools participated in all phases of the experiment. Different schools had different combinations of interventions and were organized into three groups. The groups were defined by which of the three phases they experienced. Again, schools appeared in particular group due to scheduling for screenings and SVA visits, changes to protocols, and data collection by BCHD, not due to deliberate assignment by researchers.

While the groups differed according to the proportion that were elementary versus elementary/middle schools, they did not significantly differ in demographics or prior achievement (Table 9). Group 1 (ABC) is shown in Figure 8, with the five schools that included a baseline phase, an SVA support phase, and an SVA + group incentives phase, which can show the impact of SVA support alone as well as the impact of SVA support in addition to group incentives. Group 2 (AC) is shown in Figure 9 with the three schools that experienced a baseline phase as well as an SVA + group incentives phase. These Group 2 schools demonstrate the change in consent rate from baseline to the SVA + group incentives, without showing the separate impact of SVA support alone. Figure 10 shows Group 3 (BC) with the five schools that experienced an SVA support phase followed by an SVA + group incentives phase. These five schools received SVA support immediately following their first screening and therefore did not experience a baseline phase without support. These schools were offered incentives later, so they could only establish a stable consent rate under the SVA support condition and again under the group incentives condition. Each of these types of schools is examined separately, and the numeric results are summarized in Table 10.

Baseline => SVA support => SVA + Group Incentives

There were five schools that had a long enough implementation period to establish a baseline consent rate, as well as a period of SVA support without incentives, followed by the addition of group incentives (Figure 8). The baseline consent rates at these schools ranged from 12% to 31%, with a mean consent rate of 21%. The consent rates increased in all schools with the addition of the SVA support, with a mean increase of 26%. All schools demonstrated the immediacy of the impact, with the increase beginning shortly after the start of the SVA support, though it took several weeks for the consent rate to stabilize under the SVA condition. In three

out of five schools the consent rate more than doubled. The consent rates during the period of SVA support ranged from a 41% to 53%, with a mean of 47%. After this period, group incentives were introduced, and all schools saw a further increase in their consent rate, with a mean gain of 22%. In all five schools this increase occurred shortly after the introduction of group incentives. This increase was smaller in some schools (e.g. Schools A & E), but in some schools the consent rate nearly doubled (e.g. Schools C & F). The consent rates in this final phase (SVA support + group incentives) ranged from 56% to 83%, with a mean of 69%.

Baseline => SVA + Incentives

Three schools had an initial period without SVAs or incentives (Figure 9). The introduction of SVA support was followed by incentives within a week or less, so they were essentially simultaneous. The baseline consent rate at these schools averaged 43%, with a maximum of 66% and a minimum of 26%. After the addition of SVA support + group incentives, the rate at all schools increased to a mean of 73%, with a maximum of 91% and a minimum of 49%, giving an average increase of 30%. There was an immediate effect of the SVA + group incentives, demonstrated by a change in slope right after the introduction of this phase.

SVA support => SVA + Group Incentives

Five schools received SVA support immediately following their first screening and therefore did not experience a baseline phase without support (Figure 10). The average consent rate with SVA support was 48%, with a minimum of 34% and a maximum of 66%. The addition of group incentives raised the consent rate to an average of 55%, with the lowest consent rate at 44% and the highest consent rate of 73%. All schools increased their consent rates, with an average increase of 7%. The effect of group incentives was immediate in four of the five schools.

School M saw a delay between the start of the group incentives and an increase in consent rates returned.

Discussion

The purpose of this study was the examine whether additional support staff and the use of teacher incentives had an impact on the rate of consent form return for a school-based eye care program. Active consent to participate in the program was a barrier to providing services to students in need. Results suggest that utilizing additional support staff as well as teacher group incentives are each effective strategies to increase the number of students utilizing a school-based vision program.

The support of external staff, in this case the SVAs, was successful in increasing consent rates at all schools. Their assistance appears to have helped ensure that the entire school was aware of the program, understood the importance of returning the form, and assembled the resources necessary to implement strategies to collect forms. Additional follow-up visits by the SVAs maintained this momentum in schools.

The addition of group incentives for teachers had a further effect on consent return, likely due to a combination of factors. Even with additional staff efforts in the SVA phase, teacher involvement was limited, and thus not all teachers were fully aware of the program. The group incentives increased engagement with the consent process, providing additional motivation for teachers. Principals' increased excitement about the program helped enhance their efforts to share information with teachers. The group incentive was based on a school-wide goal, so there was an element of interdependence that encouraged teachers to encourage their students to bring in their forms. Beyond the modest value of the school supplies, teachers and principals took it as a point of pride to meet the criterion. Once teachers were engaged, they used a variety of

strategies to contact families and promote consent return. Both strategies were effective at increasing consent return rates markedly, but it appears that maximizing the consent rate relied on both SVAs to prepare teachers with the necessary resources as well as group incentives to provide the additional motivation and energy.

The costs for such strategies in this project were moderate. The three SVAs provided the additional support while completing other duties related to the school-based vision care project. The cost of supplies for teachers was also low. In an age of scarce resources, this was a cost-effective way to maximize participation in a vision program that can have meaningful impacts on students. The difference between the initial low consent rate prior to the study of 26% and the final average consent rate in these thirteen schools of 65% is substantive. To put that in perspective, in just these thirteen schools an additional 696 students participated in school-based vision services after these strategies were implemented. Providing access to vision care for that many students with likely vision problems will have a meaningful impact for those students and those schools.

These findings differ from much of the previous work that has been done on increasing consent rates. In many prior studies, the focus has been on increasing the rate of consent for participation in a research study (Blom-Hoffman et al., 2009; Esbensen et al., 1996; Thompson, 1984). In studies that examined increasing consent rates for school-based health programs (Mak et al., 2011), the strategies tested have not included increasing support provided to schools, as the SVAs did in the present study.

Study Limitations

This study has several limitations to be aware of. First, this took place in a limited number of schools. While the replication of the impacts across thirteen schools increases the

external validity, it cannot be assumed that the findings would automatically generalize beyond the setting of the study. Further work must be done to test whether these approaches using additional support staff and group incentives would work as well with older students, outside high-poverty, urban settings, or for programs dealing with needs other than vision care. While it does provide a promising approach to increasing participation in such programs, further studies are needed to assess how generalizable such results are.

Another limitation to consider is that while the intended research approach was a clean non-concurrent multiple baseline design, this took place in the context of a large-scale project in numerous schools. This study experienced all of the "messiness" that comes from conducting field research in schools. One example is that while there was every intention that all schools should experience the baseline, SVA support and SVA + incentives phases, in reality that did not occur. The scheduling of when schools would receive their two rounds of screening, as well as when the incentives were offered to schools, was completely out of the hands of the research team. As the project evolved, the on-the-ground implementation teams adjusted their scheduling to better fit schools and staffing. This meant that some schools never experienced a baseline period without SVAs or that they jumped straight to the SVA + incentives phase. Another challenge was that of data collection. Due to staffing limitations and school schedules, there were weeks when the consent rates were not reported, so that there were missing data, in particular around the winter holiday. These challenges, related to the fact that this study took place "in the real world", mean that the results need to be interpreted with some caution.

Another factor that should be considered is that there are outside events that had an impact on the consent return rate. Because this was field research and not a controlled lab setting, there were events that were outside the control of the research team, and yet impacted the

outcomes. For example, there were no consent forms collected over the winter school holiday in December, while school was closed, so the return rates appear stable during that period for all schools, but in reality, this is simply a pause in program services. Then upon the return to school in January, many schools were re-energized with the new year and many schools experienced a small bump in consent returns. There were other factors that increased consent returns, such as a large media event in the spring celebrating the 1000th pair of glasses distributed that brought positive attention to the program and excitement about participation. Another outside event was a letter in the spring sent from the CEO of schools to all program schools, where each school was told their personal consent rate return as well as that they need to collect more consent forms. As the program received more positive attention and public awareness increased, schools were more receptive and enthusiastic about participating. Schools that received services in the end of the year had higher initial consent rate returns that schools that received services in the beginning of the year. This was likely due to greater knowledge of and trust in the program. This means the schools in the latter half of the school year may have started their consent rates higher initially, but even so, the strategies tested in this study were able to positively increase the number of students participating.

Outside factors also had a negative impact on consent rate return. In the late winter, there was news of a large budget shortfall that would result in layoffs and increases to class size that would affect every school in the system. This resulted in reduced morale at schools and teachers who had little energy for additional duties such as the work involved in proactively collecting consent forms. While these outside events contribute to additional noise in the consent rate return over time, the graphs still show that, despite these outside forces, both SVA support and the use

of teacher group incentives were still able to increase the number of signed permission forms returned to schools.

A final limitation has to do with the consent form itself. The consent form for services, which parents had to sign and return, was part of a double-sided form, which included information about being part of the research study associated with the project on the back. Parents may have chosen not to return the signed form because they had concerns about the research component of the project. The form gave the option to opt out of the research study with no consequences, but parents might have been uneasy about giving permission for their child to do something associated with an experiment or research, especially when it was connected to medical care. This was especially evident immediately following the release of the Henrietta Lacks film, when several SVAs reported schools receiving feedback that parents wanted to keep their child out of any research study. It is unclear to what extent this played a role in consent form returns, but consent rate returns should be interpreted with this in mind.

Conclusion

The results of this study have a practical importance in schools today. Many students lack access to important services, such as vision (Basch, 2011; Ferebee, 2004; Kemper et al., 2004; Qiu et al., 2014), which has negative consequences for their health, education, and economic outcomes (Dudovitz et al., 2016; Esteso et al., 2007; Hannum & Zhang, 2012; Kodjebacheva et al., 2015; Pavithra et al., 2014). Schools are an ideal location in which to fill this gap in access, yet programs often require that parents or students provide active consent to participate. The reach and impact of these programs rely on having effective ways of gaining consent for participation. These findings demonstrate that additional support staff as well as group incentives

for teachers provide a simple, replicable way to increase consent return rate and increase access to school-based services for children in need.

Chapter 4: The Impact of School-Based Vision Care on Children's Compliance with Eyeglass Wear Prescriptions

Introduction

Refractive error is a quite common problem for children, with estimates as high as 20% of students having a vision disorder that requires glasses (Ferebee, 2004). These refractive error disorders have an accepted and simple solution: glasses (Vitale et al., 2006), yet many students are unable to receive the services needed to address the problem (Qiu et al., 2014). The gap between widespread need for vision services and accessible care is especially wide for students living in poverty and underrepresented minorities (Basch, 2011; Kemper et al., 2004).

One solution growing in popularity to address these high levels of unmet need are models of school-based eye care (Ethan & Basch, 2008). Because traditional school vision screening programs are often unable to provide high levels of comprehensive eye exams for children (Kodjebacheva et al., 2015), school-based vision programs are implemented to bring the entire process directly to schools, from initial screening to eye exams and fitting glasses. There are numerous barriers to accessing service and receiving needed glasses after a failed vision screening in a traditional model that such school-based vision programs attempt to overcome (Kimel, 2006; Kodjebacheva et al., 2015; Mark & Mark, 1999; Preslan & Novak, 1998; Su et al., 2013). Schools have a pressing need to decrease the number of students with unmet vision needs, given the link between vision and academic success. Evidence supporting this connection is widespread (Dudovitz et al., 2016; Esteso et al., 2007; Hannum & Zhang, 2012; Pavithra et al., 2014), with one experimental study in China reporting that students who were given glasses at school scored significantly better on a math test than those who received only a glasses prescription or a voucher to purchase glasses (Ma et al., 2014), and another study in Baltimore

that found improvements in reading performance among second- and third-graders with refractive error given free glasses when using liberal criteria for prescribing glasses, compared to students who did not need glasses (Slavin et al., in press).

One model of school-based vision care is currently being implemented in Baltimore. This project was further described in Chapter 2. The present study examined whether such a program had an impact on students wearing the glasses they had received. Yet simply providing students with glasses is not enough to improve outcomes for students; the glasses must be worn regularly as well, and past research has shown that children often do not wear the glasses they are given.

Literature Review

Compliance

Multiple studies have followed up students given glasses over various periods of time. Follow-up compliance rates are show in Table 1. These studies of students' compliance rates at follow-up have been conducted across a wide range of age groups, in diverse geographic locations, and with varying follow-up times. The compliance rates vary widely, with three studies showing very low compliance of 30-47% and two studies having much more success with compliance, with between 73-86% of students wearing their glasses at follow-up. While two studies demonstrated higher compliance, this occurred in either an exceptionally small study with only 15 students (Kodjebacheva et al., 2014), or glasses compliance was assessed through a survey completed by school staff, that included the possibility of reporting regular use of glasses, but without verifying actual glasses wearing by outside staff (Alvi et al., 2015). The generally low rates of compliance illustrate the challenge in addressing children's' vision impairments;

giving children glasses does not ensure their regular use. There are several factors to consider when explaining these patterns of compliance[1].

Age. A frequent trend across settings was that compliance with wearing glasses decreased with age, so that younger students were more likely to wear their glasses at follow-up than were older students at follow-up. (Aldebasi, 2013; Alvi et al., 2015; Castanon Holguin et al., 2006; Keay, Zeng, Munoz, He, & Friedman, 2010; Pavithra et al., 2014; von-Bischhoffshausen, Muñoz, Riquelme, Ormeño, & Silva, 2014). The reasons given for not wearing glasses were also split by age, with young students more often losing or breaking their glasses (Kodjebacheva et al., 2014; Messer et al., 2012; von-Bischhoffshausen et al., 2014). Older students frequently choose not to wear glasses for social reasons, such as fear of teasing or concern with their appearance (Castanon Holguin et al., 2006; Horwood, 1998; Odedra, Wedner, Shigongo, Nyalali, & Gilbert, 2008; Rustagi, Taneja, & Uppal, 2012; von-Bischhoffshausen et al., 2014).

Gender. A pattern related to gender appears in the prior research on compliance with glasses use. Girls tend to have higher rates of compliance than boys (Congdon et al., 2008; Gogate et al., 2013; Keay et al., 2010; von-Bischhoffshausen et al., 2014). The reasons given for not wearing glasses also tended to differ by gender; girls were more likely to say they did not need their glasses, while boys were more likely to give excuses such as lost or broken glasses or that the glasses are uncomfortable or cause headaches (Aldebasi, 2013).

Socioeconomic status. A thread throughout these studies is the relationship of socioeconomic status with compliance with glasses. In two separate studies in India, glasses

[1] While the focus of these studies is on the United States, there is a rich literature spanning the globe related to compliance to glasses use. These studies have been included in the discussion of factors related to compliance, but in some cases factors that are very specific to one local culture that are not likely to generalize to an urban setting in the United States were excluded. Additionally, in cases where the culture may make a difference or may explain contradictory findings, the settings are mentioned.

compliance was higher in students whose fathers had higher levels of education (Gogate et al., 2013; Pavithra et al., 2014). A similar finding comes from the United States, where elementary students from lower socioeconomic backgrounds were less likely to be wearing their glasses at follow-up (Kodjebacheva et al., 2014). Not all studies have replicated this relationship between socioeconomic status and compliance. Keay and colleagues (2010) reported the opposite trend in urban China, where students from lower socioeconomic backgrounds were more likely to be wearing their glasses after one month.

Race, ethnicity, & culture. The studies examining compliance with glasses use come from a diverse set of contexts. The reasons given for non-compliance are often related to race, ethnicity, and culture. In some communities, such as those in China, Tanzania, and India, there is a belief that glasses are harmful, which is often given as a factor in lower rates of glasses use (Li et al., 2010; Odedra et al., 2008; Rustagi et al., 2012). There are other community beliefs that may prevent children from wearing glasses, such as that it will be more difficult for girls to marry if they wear glasses (Rustagi et al., 2012) and that traditional medicine is better at improving vision than glasses (Odedra et al., 2008). Differences across cultures were also documented in the United States; African American and Latino students have been found to be less likely to wear their glasses after six months than White students (Kodjebacheva et al., 2014).

Vision. It is reasonable to believe that students who saw a greater benefit from wearing glasses would be more likely to continue to wear them. This is borne out in most follow-up studies. Students with greater refractive error or more severe vision deficits are more likely to comply with glasses use (Alvi et al., 2015; Castanon Holguin et al., 2006; Gogate et al., 2013; Messer et al., 2012; von-Bischhoffshausen et al., 2014; Yi et al., 2015). One study that breaks this pattern took place in Baltimore, and found that students prescribed glasses with liberal

prescribing criteria (i.e. they had mild refractive error, yet may not have received glasses otherwise) were equally likely to wear glasses as those with more severe refractive error (Slavin et al., in press).

Students have also reported that they do not wear their glasses because they do not need them (Aldebasi, 2013; von-Bischhoffshausen et al., 2014). Because these students do not see an improvement of their quality of life with glasses, they are unlikely to develop the habit of regular glasses use.

Overall, there is substantial variation in the degree to which students wear their glasses after they are provided glasses at school. While some studies do show positive results, with large numbers of students wearing glasses months after they are provided, these only occur in smaller or less rigorous studies. This is concerning because glasses only help if they are regularly worn as prescribed. These findings suggest that improving access to vision care by providing glasses in schools is necessary but not sufficient to ensure that those glasses are used properly. Because of the challenge of maintaining glasses use among students after eyeglass delivery, aspects of program delivery were examined to identify critical factors in effective delivery.

Fidelity of Implementation in School-Based Vision Programs

Fidelity of implementation has not been widely reported or examined within the literature on school-based vision programs. While there are many studies that report on compliance with vision treatments, very few studies report on how glasses are delivered to schools or how well schools are adhering to the intervention. This is an important gap in the literature to explore. Prior studies are built on the assumption that the vision program is being delivered exactly as intended to all participants, but there is little to support that assumption and a long history of insufficiently implemented programs suggesting that it may in fact not be occurring.

Summary of Literature Review

The vision literature clearly demonstrates that there is a high need for vision services for students, but that compliance has been low in attempts to provide students glasses. Additionally, fidelity of implementation of the vision services has not been examined. If the long-term goal is to scale up these school-based services so that all students who need glasses have them, we need to better understand the process of how these vision interventions are enacted. The present project was designed to examine the effectiveness of the implementation of a school-based vision care model designed to ensure that all students needing glasses receive and wear them.

Theoretical Framework

This series of studies is framed by the Dimensions of Strategic Change (Pettigrew & Whipp, 1992), which identifies three dimensions that interact to contribute to successful change (see Figure 5). It emphasizes the "what" or the content of the intervention, the "how" or the process of implementation, and the "where" or the context in which the change is occurring. The present study focused on both the efficacy of the content dimension, as well as the role of the process dimension on the impact of the content.

Within this larger framework, the present study drew from the field of implementation research to understand the process dimension through the concept of fidelity of implementation. Dane and Schneider (1998) described how fidelity could be understood as a multi-dimensional construct. They identified five dimensions of fidelity that have been measured within effectiveness studies: adherence, exposure, quality of delivery, participant responsiveness and program differentiation. These five dimensions of fidelity measure wide-ranging aspects of "doing the program". There is however no consensus as to the role of these dimensions. Some argue that the different dimensions represent alternative ways to measure the implementation

process (Dane & Schneider, 1998; Dusenbury, Brannigan, Falco, & Hansen, 2003), while others argue that all dimensions must be assessed and combined for a full understanding of the process (Carroll et al., 2007). The present study used both approaches, by first examining a measure of how many eligible students ultimately received all program services (adherence), as well as exploring the individual components including coverage, participant responsiveness, and exposure. Understanding both the role of an overall measure of process as well as how different aspects of implementation relate to impacts helps illuminate what part of the process matters for successful change.

Purpose

The purpose of this experimental study was to examine the effectiveness of the implementation of the Vision for Baltimore model of school-based vision care on glasses usage rates by students in grades prekindergarten through eighth grade. The fidelity of implementation was examined to better understand why implementation of school-based vision care is successful in some schools and what additional supports may be needed. This purpose led to the following research questions.

Research Questions

Research Question 1: What is the impact of the Vision for Baltimore model of school-based vision care on glasses usage rates?

It was expected that the school vision support from Vision for Baltimore would result in higher rates of glasses use.

Research Question 2: What is the impact of the Vision for Baltimore model of school-based vision care on glasses usage rates on students in different grades?

Based on previous research examining compliance with glasses use, it was expected that there would be a different in glasses usage rates between older and younger students. It is important to understand whether the program may have differential impacts on students in different grades. While the literature also documented a difference related to gender and ethnicity, the data was unavailable to look at gender and ethnic subgroups.

Research Question 3: To what extent is fidelity of implementation associated with the rate of glasses use?

There would likely be variation in the degree to which schools implement and participate in this model of school-based vision care across the multiple components of the program (screening, consent, examination, dispensing). It is important to understand how the fidelity of implementation is related to the effect of the program. It was expected that the impact of the program, as measured by the number of students wearing glasses, would increase as the fidelity of implementation increases.

Method

Research Design

This study was conducted as part of a multi-year experiment evaluating the efficacy of the Vision for Baltimore model of school-based vision care. Schools were originally randomized to three cohorts, with each cohort receiving vision services in a different year. Because the implementation of the program differed substantially between the first and second year, this study focused on schools receiving services in the second year as the treatment sample, and schools that had not yet received services as the control sample. The use of a randomized design allowed for stronger conclusions that differences in glasses usage between schools were likely due to the Vision for Baltimore program and no other factors.

Sample

Schools in the study included schools participating in the research study of the school-based vision program in Vision for Baltimore as described above. These schools served students in prekindergarten through eighth grade. There were forty-two schools originally assigned to receive services in the second year of the project, the treatment sample, and forty-three schools assigned to receive services in the third year of the project, who had not yet received services and were the control sample.. By comparing the glasses usage rates of in Spring 2018 between these two groups, the impact of the program on glasses use could be tested.

The analytic sample for this study was schools with non-missing glasses counts which received full treatment (i.e. glasses were dispensed to students) prior to the glasses observation visit. This resulted in a treatment-on-the-treated analytic sample that focused on those schools that were actually served by the program.

Data Collection

Outcome measure.

Percent wearing. This was the percent of students wearing glasses at a school during a school visit. This was calculated as the number of students wearing glasses at the school divided by the number of students present at school that day. This was the compliance rate of students wearing glasses. These data were collected by the study research team from JHU. Researchers scheduled a time to visit the school to conduct the glasses count. All counts were conducted in the morning, prior to the start of the lunch period, in order to find all students in classrooms during academic lessons where they would be wearing their most likely to be wearing glasses as needed. The observer would receive guidance from the office about how many classes there were at each grade, as well as the locations of each class. Then the observer would visit each class, to

count both the number of students wearing glasses, as well as the number of students present. Teachers would tell the observer if any students were elsewhere in the building, such as at a pull-out or special service, so they could be located and counted. The observer would also check any other rooms they found, for any students that were missed. While this method cannot guarantee capturing 100% of students, the combination of asking for classroom and teacher assignments at the office, seeking student locations with teachers, and checking all rooms in the building identified and counted the most students possible. It is unlikely that any students that were missed differed substantially from students that were counted in terms of glasses use.

There are several key assumptions that need to be understood for this outcome measure. First, it assumed that the need for glasses and the rate of access to care prior to the program is the same between treatment and control schools, which is probable due to the randomized design as well as the equivalence on numerous other factors. It also assumed that because the treatment is providing access to vision care in schools, the number of students being prescribed glasses is higher in treatment schools. This also assumed that the percent of time students with glasses need to be wearing them is the same in treatment and control classes. The issue is that some students only need glasses for reading but happen to be in the middle of a lecture when the observer visits; they may wear their glasses as needed (in reading), but would not be counted as complying. Yet the number of students with glasses who are not expected to wear them full time was small and should be equal across schools. Researchers noted how many students have glasses available to wear in these cases.

Fidelity measures. The Vision for Baltimore project has several steps, each of which much be completed in order for the program to be effectively providing glasses to students. Each of these different components (screening, consent, examination, dispensing), can be assessed to

determine the degree to which eligible students are in fact receiving the service. Poor implementation of any of these individual components will result in fewer students receiving glasses, which should lead to fewer students wearing glasses. The main measure of fidelity was the proportion of students completing the project out of students eligible for the program. This was a comprehensive measure of program adherence, or the degree to which the program was delivered as intended.

In addition, there were four component fidelity measures. These included: the proportion of students participating in the screening, returning consent forms after failing the screening, receiving an eye exam on the mobile eye clinic, as well as the number of days that students had their glasses. These measures were also examined because each relates to a different part of the process and provides information on the degree to which each component was delivered. Fidelity measures were only collected in treatment schools. Details on each of the measures are given below.

Percent completed. This was the proportion of students who completed the program. This was calculated as the total number of students receiving vision exams divided by the number of students eligible for the program (students who failed their vision screening). This information is available from BCHD and VTL. This was the comprehensive measure of fidelity.

Percent screened. This was the percent of students at a school screened by BCHD. This is calculated as the total number of students screened at a school divided by the total enrollment of the school. This is a component of the implementation process that focused on coverage related to program delivery by BCHD. This information is available from BCHD.

Percent consented. This is the percent of students who failed their vision screening and required further care whose parents consented to school-based vision care provided by VTL.

This was calculated as the total number of students whose parents submitted forms consenting to school-based vision care at a school divided by the total number of students who failed the vision screening at that school. This was a component of the implementation process that focused on parent responsiveness. This information was available from BCHD.

Percent examined. This was the percent of students who actually received eye exams from VTL. This was calculated as the total number of students who received a VTL exam at a school, divided by the total number of students who returned a signed consent form at that school. This was a component of the implementation process that focused on coverage related to program delivery by VTL. This information was available from VTL.

Treatment Decay. This was a measure of how long students had their glasses. This was calculated as the number of days between the date that glasses were dispensed to students and the date that the school was visited for glasses to be counted. This was a component of the implementation process focused on exposure, or how long students were exposed to the treatment. This information came from dispensing dates from VTL as well as observation dates from the JHU research team.

Data Analysis

Research Question 1: Impact Analysis. For the impact analysis, a t-test was used to examine whether there is a significant difference in the glasses use rate between schools receiving school-based vision services and schools not yet receiving those services. The dependent variable was each school's glasses use rate and the independent variable was whether the school received school-based vision services.

Research Question 2: Impact Analysis by Grade. For the grade-level impact analyses, a t-test was used to examine whether there was a significant difference in the glasses use rate

between schools receiving school-based vision services and schools not yet receiving those services within each grade band. The dependent variable was each school's glasses use rate and the independent variable was whether the school is receiving school-based vision services. There were three grade bands examined: lower elementary (prekindergarten through second grade), upper elementary (third through fifth grade), and middle school (sixth through eighth grade), resulting in a total of three analyses (lower elementary, upper elementary, middle school)

Research Question 3: Role of Fidelity. The role of fidelity was examined with linear regression, with the data was limited to the treatment sample only A series of linear models was estimated to assess the extent that fidelity of implementation was associated with glasses use. This step employed the following general regression model:

$$percent\ wearing = \beta_0 + \beta_1 Implementation + e$$

In the first model, the comprehensive measure of implementation fidelity was used. The implementation term was examined for significance. It was predicted that the higher the fidelity of implementation at a school, the greater the impact of the program will be. Next, each of the four components of implementation were substituted in turn into the model, to examine whether they contributed significantly to the outcome. Finally, a model was estimated with all four components included to see if they, together, predicted glasses usage.

The main analysis examining the association of glasses usage and implementation used the proportion of students who completed the program by either receiving glasses or passing a vision exam (percent completed). The process was repeated with each of the four additional indicators of implementation (percent screened, percent consented, percent examined, and treatment decay).

Results

Baseline Equivalence & Analytic Sample

The schools were randomized to cohorts and resulted in balanced groups. There were no statistically significant differences at randomization in terms of school structure, size, demographics, prior achievement, or student characteristics (see Table 3). Any differences in the outcome can be attributed to the treatment rather than existing differences between groups. Schools were removed from the sample for three reasons (Table 11). First, one school from the treatment group and three schools from the control group were closed by the district after randomization and thus these losses were beyond the control of the research team. Second, twelve schools (5 treatment and seven control) did not have a glasses usage count. In each of these schools attempts were made to visit the school to assess glasses use, but in each case the school either refused to allow the research team to visit the school or the school was non-responsive to multiple attempts (multiple phone calls, emails, and at least one in-person visit) to schedule the observation. The numbers and types of schools refusing visits for glasses observations were similar across conditions, so this did not create differential attrition.

Finally, because we were interested in the effect of the Vision for Baltimore model on glasses usage rates, the sample was limited to schools that were served by the program prior to their end of year glasses observation visit. Twelve of the schools randomized to treatment in this year did not receive exams or glasses before their end of year visit, so they were removed from the sample. This resulted in an analytic sample of 25 treated schools and 33 control schools. These schools remained similar on observable characteristics, with no significant differences in school structure, size, student characteristics, or prior achievement (Table 12). The analytic sample appeared quite comparable.

Research Question 1: Impact Analysis

To answer the first research question, a t-test was conducted to examine whether there was a significant difference in the glasses use rate between schools receiving school-based vision services this year and schools not yet receiving those services. Before the t-test was conducted, assumptions of normality and heterogeneity of variance were assessed. The data were found to violate the assumption of normality due to extreme outliers. The data were winsorized, where values beyond three standard deviations from the mean were identified as outliers and replaced with the maximum value not identified as an outlier. Two values, one in each condition, were identified as outliers using this criteria and were replaced. The assumptions were re-checked and the data met requirements for normality and heterogeneity of variance.

The results of this analysis are shown in Table 13. There was a significant difference in glasses usage rates, with 12% of treatment students (SD = 0.04) and 9% of control students (SD = 0.04) wearing glasses ($t(56) = 2.715$, $p < .01$). These results suggest that the Vision for Baltimore model of vision care does have an effect on glasses usage rates by students. Specifically, schools that received the Vision for Baltimore school-based vision services had more students wearing glasses.

Research Question 2: Impact Analysis by Grade

To answer the second research question, t-tests were used to examine whether there was a significant difference in the glasses use rate between schools receiving school-based vision services and schools not yet receiving those services within each grade band. Each grade band was analyzed separately. Before each analysis, the assumptions of normality and heterogeneity of variance were assessed. In two out of three cases, the presence of outliers was causing a non-normal distribution. In each case, outliers were replaced using a winsorization technique. The

assumptions were re-checked and the data met requirements for normality and heterogeneity of variance before the analyses proceeded.

Lower Elementary Grades. The impact of school-based vision services on glasses usage rates among prekindergarten through second grade schools was examined using a t-test. Table 14 shows the results of this analysis. There was a significant impact of treatment in the lower elementary grades ($t = 2.58$, $p < .05$). On average, 9% (SD = 0.05) of students in treated schools were wearing glasses, while 6% (SD = 0.02) of students in control schools were wearing glasses. There appears to be a meaningful impact of the Vision for Baltimore program on the number of students wearing glasses in the younger grades.

Upper Elementary Grades. The impact of the Vision for Baltimore program on glasses compliance for students in grades three through five was also assessed using a t-test (Table 15). There was no significant impact of the intervention on glasses usage rate in the upper elementary grades ($t = 1.66$, $p > .05$). For these students, 13% (SD = 0.06) of students in treated schools were wearing glasses, and 11% (SD = 0.05) of students in control schools were wearing glasses. Based on these findings, we cannot reject the null hypothesis that there is no difference in glasses usage rates between schools served by the program and those that had not yet received the treatment.

Middle Grades. A t-test was used to test the impact of school-based vision services on the glasses wearing of students in grades six through eight. For middle grade students, there was no significant effect of the Vision for Baltimore program ($t = 1.88$, p - .07) (Table 16), while the glasses usage rate was non-significantly higher in treatment schools, where 19% of students were wearing glasses (SD = 0.05), compared with 15% of students in control schools (SD = 0.07).

These results suggest that there is not difference in the number of middle school students wearing glasses between treatment and control schools.

Research Question 3: Role of Fidelity

To answer the third research question, glasses use was regressed on measures of fidelity of implementation. There were five measures of fidelity of implementation: the main comprehensive measure, the percent of students successfully completing the program, as well as four additional component measures. These components included the percent of students screened at a school, the percent of students returning signed consent forms to participate in the program, the percent of students who received a vision examination, as well as a treatment decay measure of how many days had elapsed since glasses were dispensed. Descriptive statistics for these five measures are reported in Table 17.

To examine this question, a series of linear models was estimated (Table 18). In the first model, the comprehensive measure of treatment, the proportion of students to successfully complete the program, did not predict the proportion of students wearing glasses in schools (β = 0.01, n.s.). The next step was to examine the role of each of the components of fidelity. Because each of these measures assessed different aspects of the process, it was important to explore the degree of correlation among the components. These correlations are shown in Table 19. The only significant correlations are between the comprehensive fidelity measure and screening rate, as well as the comprehensive fidelity measure and consent rate. Because the individual components are not correlated with each other, each was assessed in the model separately, with the percent of students screened in Model 2, the percent of students returning consent forms in Model 3, the percent of students receiving exams in Model 4, and the treatment decay of how many days a school had had glasses in Model 5. All fidelity components were included together in Model 6.

In models 2-5, each of the components of fidelity was substituted for the comprehensive fidelity measure. The only fidelity component to significantly predict the glasses usage rate was treatment decay (Model 5, β = -0.0003, $p < .05$). Treatment decay had a negative relationship with glasses usage, so that the longer a school had their glasses, the fewer students were wearing glasses. For example, a school that had received their glasses 100 days prior to the glasses count observation had a glasses wearing rate 3% lower than a school that has just received glasses.

The findings of interest in the fidelity component models are highlighted. First, in Model 2, Model 3, and Model 4, the fidelity component variable was not a significant predictor of glasses use, a pattern similar to that with the comprehensive fidelity model. In Model 5, treatment decay significantly predicted the glasses usage rate (β = -0.0003, $p < .01$). Treatment decay had a negative relationship with glasses usage, so that the longer a school had their glasses, the fewer students were wearing glasses. For example, a school that had received their glasses 100 days prior to the glasses count observation had a glasses wearing rate 3% lower than a school that has just received their glasses. In the final model with all components of fidelity, the treatment decay was the only significant predictor (β = -0.0003, $p < .05$).

Discussion

This study sought to examine whether a school-based model of vision care, Vision for Baltimore, would have an impact on the glasses usage rate in schools as well as the role of fidelity of implementation in that relationship. The results of this study provide evidence that school-based vision programs can increase the number of students wearing glasses in schools. While it may appear obvious, that a program that provides glasses to students in schools should result in higher numbers of glasses used in those schools, prior research in the United States has shown that this is not always the case. In some programs, compliance with glasses use was

higher, with large proportions of students who received glasses wearing them (Alvi et al., 2015; Kodjebacheva et al., 2014). Other programs saw the opposite pattern, with fewer than half of the students provided glasses wearing them upon follow-up (Ethan et al., 2010; Messer et al., 2012; Preslan & Novak, 1998). The present study showed that school-based vision services can increase the number of students wearing glasses, which is an important finding, supporting the importance of continuing to support and develop these approaches to closing the gap in unmet vision need. Yet that increase was only a 3% gain, or on average, 12 students per school. It appears clear that this model, which included the vision care as well as limited school support, is not enough to keep all students provided glasses wearing them regularly at school. More work is needed to discover what would be needed to make sure that all students who receive glasses are wearing them.

These findings also examined whether the impact of glasses usage varied across grades. While the impact was significant in the lower elementary grades, it was not significant in the upper elementary grades or in the middle grades. This implies that there was a significant impact of the program on younger students, but not on older students. This is in line with previous work examining compliance in children (Aldebasi, 2013; Alvi et al., 2015; Castanon Holguin et al., 2006; Keay et al., 2010; Pavithra et al., 2014; von-Bischhoffshausen et al., 2014), where compliance was highest among the youngest students. If younger students are more likely to wear glasses as prescribed, they would be more likely to show an impact of a school-based vision model as measured by glasses use.

There may be several explanations for the contradictory pattern found in this study. First, there may not be enough statistical power to detect the impact in the older grades. The sample was only 55 schools in the upper elementary grades and even fewer (N = 32) in the middle

grades. The lack of statistical significance in the other grades may reflect an underpowered analysis. Another possible explanation is that this reflects a true difference, with the program having impacts with younger students but not with older students. There were reports from educators and program staff that younger students were very likely to break, lose, or forget their glasses. These students would benefit from adult support, such that teachers could provide in the form of reminders and encouragement, to maintain regular glasses use. The same support strategies may not translate effectively to older students.

One concern about compliance relates to teasing and bullying. However, that did not appear to be a common concern in this study. Students often reported wanting glasses, had a range of attractive frames to choose from, and in many cases were part of a large group of students getting glasses at the same time. Students who received glasses were rarely the only student in a class getting them, so there was "strength in numbers". Additionally, study team members reported small numbers of students in the older grades wearing fashion glasses. These were students who did not require glasses to see who chose to wear them anyway as a fashion accessory. That would lend credence to the idea that glasses were considered positive for students, particularly for the older students. Further work with larger samples is warranted to better understand these differences in glasses usage impacts in different age groups.

This study also sought to understand how the implementation process was related to the program impact. With the exception of treatment decay, the various implementation measures did not significantly predict glasses usage. It was hypothesized that schools with worse implementation would have lower impacts, but that was not supported by these findings. However, the importance of treatment decay was clear. This was a negative relationship, so that the longer schools had their glasses, the fewer students were wearing glasses. This suggests that

there is a drop-off in glasses use over time. It could be that as time passes, more students lose, break, or choose to stop wearing their glasses without having them replaced. It could also signal that as time passes, the energy and motivation to sustain a glasses-wearing culture at school diminishes, so that students are no longer reminded or encouraged to wear their glasses. This is a key finding and suggests that school-based vision programs cannot be considered a one-off project; they require a sustained and continuing effort on the part of schools to ensure that once students wear glasses, they continue to wear them regularly.

The lack of importance of the other fidelity measures is surprising. It is widely accepted that the quality of program implementation has an impact on program effectiveness. Yet fidelity measures (with the exception of treatment decay) did not explain any further variation in impact. There are several possible explanations. It may be that there simply was not enough variation left in those variables. This variation may have also been limited by the treatment-on-the-treated approach of this study. It could also be that the schools in this study all reached the necessary minimum threshold for these components, so that there may be a decrease in impact if implementation dropped below that limit. These could also simply not be the implementation factors that matter to measure. There are additional factors, such as quality of implementation or satisfaction with the program that may have had more power in explaining differences in impact. These are possibilities to explore in the future.

Limitations

There are a few important limitations to consider for this study. First, while this program focused on the school-based model of vision care, in the process of screening, getting consent forms, and providing exams and new glasses in schools, there was a great deal of attention paid to the need for vision care and positive attention toward glasses. It is possible that students, as a

result of that attention, accessed vision care and received glasses through other means. While that is positive and still results in closing the gap in vision care and decreasing the number of students with unmet vision needs, it does complicate interpretation of the program effect, because we measured glasses usage at the school level without distinguishing between where students received their glasses. To put this in context, the program provided glasses to 19% of the students in treatment schools, yet on average only 12% of students were observed wearing them when study team members visited schools. We have no way of knowing how many of those 12% actually received their glasses through our program or from another source as a result of our program. This illustrates that the program may function to increase glasses use through multiple pathways and we do not fully understand the degree to which each one works.

Another limitation related to the measurement of the outcome is that we also cannot tell whether students are wearing their glasses as prescribed. It is possible that there are students that do wear their glasses as needed, but they simply were not needed at the time the research team member visited the school. While researchers attempted to take note of glasses that were available for other purposes (glasses on desk that were available for reading), these examples were very limited. Again, this method of assessing glasses use may underestimate the rate of usage, but it is likely not a large difference.

Conclusion

This study examined Vision for Baltimore as a potential solution for the widespread problem of unmet glasses need. The findings provide support that such models of school-based vision care have the potential to increase the number of students wearing glasses at school. However, it also illustrated the need for continued and sustained engagement with those schools to ensure that the impact is long-term. These findings have important implications because

adequate correction can have a lifetime of positive consequences, including better learning outcomes. Students with unmet vision needs are more often found in schools with high proportions of poverty and under-represented minorities, and also experience less academic success. It is important to alleviate these vision problems as a way to improve learning outcomes for those students, and school-based models such as Vision for Baltimore show some promise to do so.

Chapter 5: Patterns in Retention and Replacement of Glasses in School-Based Vision Care

Introduction

Nearly one out of every five students require glasses due to refractive error, making vision care a widespread need among children (Ferebee, 2004). Yet many students lack adequate correction in schools and suffer from impaired vision (Qiu et al., 2014). This occurs despite the correctable nature of refractive error (Vitale et al., 2006). This gap in vision care is exacerbated for children living in poverty and children from African American and Hispanic backgrounds (Basch, 2011; Kemper et al., 2004).

While the traditional approach to addressing childhood vision needs involves school-based vision screening programs, these often do not result in children receiving the eye care they need (Kodjebacheva et al., 2015). Another solution, school-based delivery of eye care, is growing as a way to provide students with access to the vision services they need (Ethan & Basch, 2008). School-based vision programs provide the full vision care cycle, from initial screening to eye exams and fitting glasses, within the school settings. It is believed such programs can overcome the numerous barriers that prevent students from accessing care after a failed vision screening in a traditional model (Kimel, 2006; Kodjebacheva et al., 2015; Mark & Mark, 1999; Preslan & Novak, 1998; Su et al., 2013). Addressing unmet vision needs in children is vital given the primary role of vision in learning. The connection between vision and academic success is widely accepted (Dudovitz et al., 2016; Esteso et al., 2007; Hannum & Zhang, 2012; Pavithra et al., 2014), with one experimental study in China reporting that students who were given glasses at school scored significantly better on a math test than those who received only a glasses prescription or a voucher to purchase glasses (Ma et al., 2014). A study in Baltimore also found gains in reading performance among second- and third-graders with refractive error given

free glasses, compared to students who never need glasses, while using liberal prescribing criteria (Slavin et al., in press).

Yet moving vision services within the schoolhouse isn't the end of the story. Students must wear their glasses regularly, as prescribed. However, children often do not wear the glasses they are given (Table 1). This illustrates one challenge in addressing children's vision impairments through providing access to vision care; giving children glasses does not ensure their regular use.

Glasses Retention

Multiple studies of students' compliance rates at follow-up have been conducted across a wide range of age groups, in diverse geographic locations and with varying follow-up times (Table 1). The compliance rates range from a minimum of 30% of students wearing their glasses after one year in Baltimore (Preslan & Novak, 1998) to a maximum compliance rate of 86% in Philadelphia after 1 month (Alvi et al., 2015). In a number of studies where students were followed up after receiving school-based vision services and compliance with prescription glasses was assessed, students who were not wearing their glasses were asked why they were not wearing their glasses. Across different settings and groups, a frequent complaint was that students had lost or broken their prescription glasses (Aldebasi, 2013; Gogate et al., 2013; Kodjebacheva et al., 2014; Messer et al., 2012; von-Bischhoffshausen et al., 2014). Preslan and Novak (1998) even argued that the lack of a replacement process was a potential reason for low levels of compliance with wearing glasses. Failure to retain glasses provided through these school-based programs is a clear barrier to the regular use of prescription glasses.

There have been some attempts to address the issue of glasses retention. In some cases, students are provided with two pairs of glasses, often using one pair for school and another for

home (Ethan et al., 2010; Kodjebacheva et al., 2014). Yet compliance rates remain low, as even with two pairs students can still misplace their school pair or break both pairs of glasses (Kodjebacheva et al., 2014).

Focus on Organizational Factors

The organizational structures of the schools have not been examined in the context of school-based vision services. This is a gap that is necessary to explore. Because many interventions require a collective effort within an organization to implement successfully, an organizational lens is appropriate (Weiner et al., 2009). In their study of workplace health promotion, Weiner, Lewis and Linnan (2009) identified a theory of how organizational components relate to implementation, including the organizational readiness for change, the implementation policies and practices of the organization, the climate, and the fit between the intervention and the organization. Ignoring the organizational health of the schools that are the setting for school-based vision programs assumes that either there is a lack of variation in organizational factors across schools where such programs take place or that the organizational health of a school has no impact on the efficacy and implementation of such a program. Both of these assumptions seem likely to be false, so a deep understanding of how the organizational climate of a school works to support or hinder a school-based vision program is necessary.

Summary of Literature Review

There is a dearth of research on effective strategies to improve student retention of glasses. There are no studies examining how a replacement process organized through a model of school-based vision functions and whether it is associated with higher student compliance with wearing glasses. Additionally, the organizational factors that support high-quality implementation of school-based vision service that would lead to improved outcomes have not

been examined. If the long-term goal is to scale-up these school-based services so that all students who need glasses have them, we need to better understand the process of how these vision interventions are enacted, as well as how the organizational environment of the school affects their efficacy. This project carried out a study to examine the patterns of retention and replacement within the Vision for Baltimore model of school-based vision care.

Theoretical Framework

The present study was part of a larger series of studies examining different aspects of the implementation of one model of school-based vision care. This series of studies used Pettigrew and Whipp's model of Strategic Change (1992). The model argues that successful change in an organization, such as integrating a new behavior or process, relies on three interacting dimensions: the content of the change, the process of the change, and the context of the change (see Figure 5). The content refers to what change is intended to be enacted. The process identifies how the shift to the new content is to be implemented and supported. The context describes the setting for the change. The present study examines the process of implementing one component of a model of school-based vision care (a replacement process) as well as the role of the school organizational context in use of that replacement process.

Purpose Statement

The purpose of this correlational/descriptive study was to examine the frequency and variation of glasses retention and replacement in the Vision for Baltimore model of school-based vision care for students in grades prekindergarten through eighth grade in the schools in the second cohort (receiving glasses in SY 17-18). The glasses use rate was examined alongside the organizational context of these schools to better understand why implementation of school-based

vision care was more successful in some schools than in others and what additional supports may be needed. This purpose led to the following research questions.

Research Questions

Research Question 1: Do glasses replacement rates vary across schools receiving glasses in the second year of the Vision for Baltimore program?

In Vision for Baltimore, all students are offered replacement glasses at for up to one year after receiving glasses. Some degree of loss or breakage is normal and expected. It is unclear to what degree students will take advantage of this benefit or if there is variation across schools. It is important to examine how many students require replacements, how long they retained their glasses, and whether these vary across schools.

Research Question 2: How is glasses usage related to glasses replacement rates across schools?

There is variation across schools in their ability to promote regular glasses use, as evidenced by the diverse rates of compliance noted during observations. Schools with higher glasses usage rates may have a strong culture of glasses-wearing, with teachers and staff regularly encouraging students to wear their glasses. This could also lead to teachers and staff who are aware of the replacement benefit and request replacement glasses for students who lose them. If students are motivated in these schools to wear their glasses, they may also advocate for replacements through teachers or their parents. In these schools it was expected that the replacement rates will be higher, as school staff are regularly encouraging glasses use and pursuing replacements for students who lose or break their glasses. Schools with lower rates of glasses use may have less press for students to wear glasses, so that teachers and students are less motivated to acquire replacement glasses.

Research Question 3: How is a rating of organizational health related to the glasses replacement/usage categorization?

While the process for requesting replacement glasses is simple, it still requires some effort. Schools with higher levels of organizational health may have greater capacity to take advantage of the replacement benefit, because teachers may be more aware of the process, a specific person within the school may be assigned to manage this task, or staff are more likely to work together to accomplish this task. Schools with lower levels of organizational health may be focused on solving more immediately pressing problems and may be unable to summon the resources to consistently use the replacement program for students who lose or break their glasses.

Method

Sample

This study was completed as part of a rigorous evaluation of the Vision for Baltimore program. Schools were originally randomized to three groups, with each group receiving the intervention in a different year. The sample for this study came from the group of schools who received glasses during the 2017-18. These schools served students in grades prekindergarten through eighth grade who were identified during a vision screening as being at risk of vision deficits, returned consent forms to participate in the program, received a comprehensive eye exam on the mobile clinic, and received prescription glasses. Further, this study focused on the students at schools that received their vision exams and glasses prior to May 15, allowing time for replacement requests to be made prior to the end of the school year.

Data Collection

Glasses replacement.

Percent replaced. This was the percent of students who requested replacement glasses during one year of the program. It was calculated as the number of students requesting replacement glasses at a school divided by the number of students prescribed glasses at that school. These data are collected and stored jointly by VTL and JHU.

Glasses usage.

Percent wearing. This was the percent of students wearing glasses at a school during a school visit. It was calculated as the number of students wearing glasses at the school divided by the number of students present at school that day. These data were collected by the study research team from JHU.

Organizational health measure.

Organizational health. This was a categorical rating of the school's ability to implement the program. It was a rating system developed by the School Vision Advocates. Schools are rated as either "high", "medium", or "low". A rubric for how schools are categorized is shown in Table 20. These ratings are mainly based on leadership, available personnel, and communication, and are determined specifically for their ability to implement the Vision for Baltimore program, i.e. the leadership is engaged with the program. These ratings were determined by the three SVAs after several school visits. Schools were given a holistic score based on a combination of their level of each of the three categories. While leadership and communication had 3 levels, available personnel was a dichotomous rating. All organizational health ratings were discussed until consensus was reached.

These ratings appear to be strong indicators of schools' organizational health. The Baltimore City Schools conducts a Climate Survey annually, which has previously been used to assess the organizational health of schools (Durham, Bettencourt, & Connolly, 2014). The most

recent results of that survey to teachers, which had 61 individual items available, were correlated with the SVA ratings. In addition, the Baltimore City Schools organized those items into thirteen dimensions. The correlations between the City Schools dimensions of school climate and the SVA ratings are included in Table 21. Both the 3-category rating (High, Medium, Low) as well as a 2-category system that collapses Medium and Low into a single category, are significantly correlated with the Administration, Learning Climate, Finding Meaning in Work, Family Involvement, School Resources, Safety, Satisfaction with School, and Teachers dimensions. They were not correlated with the Creativity and the Arts, Physical Environment, or the District Office dimensions. This suggests that the ratings by SVAs capture the overall organizational health of the school.

The ratings were also compared with the dimensions of organizational health as defined by Hoy and Feldman (Hoy & Feldman, 1987). This model includes five dimensions: Academic Emphases, Collegial Leadership, Institutional Integrity, Resource Influence, and Teacher Affiliation. Individual items from the Baltimore City Schools climate survey were grouped into these categories by examining items from each category on the Organizational Health Inventory-Elementary, which was developed with these five dimensions and finding analogous items on the Baltimore City Schools survey. The correlations among these five dimensions of organizational health and the SVA ratings were also highly associated (Table 22). Both the 3-category and 2-category systems of ratings are significantly associated with all five categories. This was evidence of the SVA ratings' strong association with a slightly different conceptualization of organizational health. While both the 3-category and 2-category systems were similarly associated with the independent indicators of organizational health, because of the uneven

distribution of the schools in the 3-category ratings (High = 14, Medium = 6, Low = 8), the Medium and Low categories were collapsed into the 2-category system.

Data Analysis

Research question 1: Glasses replacement rates across schools. To answer the first question about how glasses replacement rates vary across schools, descriptive statistics were calculated. These include measures of central tendency (mean, median), as well as measures of variation (standard deviation). In addition, a histogram of glasses replacements rates was created. This illustrates how the rates vary across schools.

Research question 2: Glasses Replacement Rates and Glasses Use. The first step was to plot the glasses replacement rate versus the glasses use rate to determine the shape of this relationship. Outliers were examined and replaced using a winsorization method. Because this did not result in a linear relationship, the relationship was then examined using a categorical approach. Schools were classified as either high- or low-replacement and either high- or low-wearing. A two by two table was created to organize these categories and examine the relationship between glasses use and replacement rates.

Research Question 3: Glasses Replacement Rates and Organizational Health. Because this was not a linear relationship, the two by two table categorizing schools as having high or low replacement and usage rates was used, this time subdividing the schools between high and low organizational health ratings in each cell. We examined how many of each type of school fell into each box of the table. This was a straightforward way to explore what patterns of replacement and usage were found at each level of organizational health. The school replacement rates and usage rates were also plotted again, this time color-coding each point for its organizational health rating.

Results

Analytic Sample

The analytic sample included 28 schools. The schools had to receive their glasses by May 15 in order to have time to place glasses requests before the end of the school year. These schools were mainly elementary (N=12) and elementary/middle schools (N=14), with few middle schools (N=2). They were typical of all schools served in the second cohort, but were the set that were served in time to have actually made replacement requests. A description of these schools can be found in Table 23. Of these, four schools were missing their end of year observation to measure the glasses usage rate. In all analyses that include glasses usage, these four schools were dropped, resulting in 24 schools.

Research question 1: Glasses replacement rates across schools

To answer the first research question about the replacement rates, both numeric and graphic summaries were examined. Descriptive statistics about the replacement rate patterns across schools are reported in Table 24. Across the 28 schools that had received services as of June 1, the mean replacement rate was 9.6%, with a standard deviation of 0.117. The maximum replacement rate was 55.7% and the minimum was 0.00%. However, the data cluster toward the x-axis, with ten schools having requested no replacement glasses. This resulted in a strong positive skew (see Figure 11). There were also extreme outliers, so the data were winsorized at the 90th percentile, meaning that data past the 90th percentile were replaced with the value of the 90th percentile. This process changed three values and resulted in a distribution that remained strongly skewed (Figure 12).

Research Question 2: Glasses Replacement Rates and Glasses Use

The relationship between the raw glasses replacement rate and the glasses usage rate was plotted in Figure 13. From visual inspection, the data are mostly clustered in the lower left quadrant and there is no apparent relationship between the replacement and usage rates. This figure also shows the extreme outliers that exist in both replacement rate as well as in usage rate. Both replacement rate and usage rate were winsorized at the 90th percentile to restrict the influence of these outliers.

The transformed data are plotted in Figure 14. The data are still spread out with no apparent relationship, though outliers still remain in the plot. Most points appear on the left-hand side of the plot, with replacement rates less than 10%.

Because a linear relationship was not apparent, the next analyses converted the data to categories. Schools with replacement rates above 8% were categorized with high replacement, while schools with replacement rates below 8% were low replacement schools. The usage rate was divided at 13%. These are organized in Table 25. Of the 24 schools with both replacement and usage rates, 33% (N = 8) are in the low-use low-replacement category. A further 37.5% (N = 9) are in the high-use low-replacement category, for a total of 70.8% in the low-replacement category. There are 4 schools (16.7%) in the low-use high-replacement category and 3 schools (12.5%) in the high-use high-replacement category.

Research Question 3: Glasses Replacement Rates and Organizational Health

To examine the role of organizational health in replacement and usage rates, schools were first rated on their organizational climate to support the Vision for Baltimore program. There were 14 schools with high ratings and 14 schools with lower ratings. Descriptions of these categories of schools are available in Table 26. Schools with high and low rates of organizational health were similar in structure, size, and student characteristics such as proportion of students

eligible for special education, limited English proficiency, and free and reduced-price meals. However, the schools differed significantly in racial make-up and prior achievement. Schools with low ratings of organizational health were more likely to have a larger proportion of African American students as well as lower achievement in both English language arts and mathematics.

The relationship between glasses replacement rate, glasses usage rates, and organizational health was first explored using a modification of the table in the previous research question. Each cell of the use replacement table is further divided for low and high organizational health (Table 27). Of the 8 schools in the low-use low-replacement category, 2 have high ratings and 6 have low ratings. Within the high-use low-replacement cell, 7 of the 8 schools had high ratings of organizational health. Across the low-replacement categories, 9 of the 17 schools had high levels of organizational health. In the low-use high-replacement cell, 3 of the schools had high ratings, while 1 school had a low rating. Within the high-use high-replacement category, 1 school has a low rating of organizational health while the remaining two schools had high levels of organizational health. Across the high-replacement categories, 5 of the 7 schools had high levels of organizational health.

These data were also represented graphically in Figure 15. This figure plots replacement rates versus usage rates, while coloring schools with high organizational health red and schools with low organizational health blue. The schools with higher ratings of organizational health tend to be clustered higher (higher usage) than the lower rated schools, as well as further to the right (higher replacement rates). There is still not a clear linear relationship.

Discussion

The present study explored the use of a glasses replacement process across schools in the Vision for Baltimore model of school-based vision care. The results of this study suggest that

there is wide variation in the degree to which schools take advantage of a replacement process. Just over 9% of the glasses dispensed were requested to be replaced. This hides the fact that the distribution was strongly skewed. Over a third of the schools participating in the program did not request that any glasses be replaced. The replacement process appears to be underutilized by schools, but it is unknown why this is the case. One possible explanation is that schools did not believe it was their responsibility to call for glasses replacements for their students. Medical care such as vision services and glasses is traditionally the role of the parent, so schools may not have been able or willing to take on this additional sphere. Another explanation is that schools were unaware of the replacement process. While schools could either email or call the program coordinator for replacements, this rarely happened independently. Many requests came after SVAs were in schools for follow-up visits or reminded schools about the replacement process. Even then, the information may have remained centralized to a few key partners within the school, rather than disseminated to all staff that work with students. In addition, there were periods in the year when the replacement procedure did not function smoothly; people who requested replacements were not contacted about the status of their request or replacements took more than two months to arrive. Schools may have made one replacement request and after no response or the long delay, simply gave up on further requests. A final explanation is that replacement requests were low because schools did not need replacements; students were wearing their glasses regularly and few had been lost or broken. While the former explanations were beyond the scope of this study, the latter explanation was explored.

This study also examined the relationship of replacement rates to glasses usage rates. This is important because this could be a strong explanation for why replacement rates were so low. If students are wearing their glasses, they likely do not need replacements. However, the

findings show little support for a relationship between replacement rates and usage rates. There were similar numbers of schools with both high- and low-usage rates in the high-replacement schools. This pattern continues in the low-replacement schools. There was no clear link between how many students were wearing glasses and how many for which glasses a school was requesting replacements.

The study also examined the potential role of school organizational health with glasses replacements and use. Here there are some interesting findings. First, among schools with high replacement rates, there are more schools with high levels of organizational health (5/7). Looking more closely at those schools, the two low-rated schools received their glasses at the start of the school year and requested their replacements in a large order in the spring. They had not been using the replacement process at all, until near the end of the year when standardized testing began. However, the high-rated schools that also had high replacement rates received their glasses throughout the year. In addition, some of these schools may have been requesting replacements for reasons other than breakage. For example, some schools, once learning that replacements took some time to process, began requesting replacements before they were needed, in order to have them available as soon as they were needed. Other schools wanted to request replacements to keep the second pair at school in the classroom, so there was always a pair available during the school day. These are schools that were able to mobilize resources to use the replacement process to their advantage, perhaps not as it was intended, but in a way that benefitted their students. This capacity appears to be related to high levels of organizational health.

Among schools with low replacement rates, there was a nearly even split between high- and low-rated schools. However, taking into account levels of glasses use, a pattern begins to

emerge. Of the low-replacement schools, the high organizational health schools tend to cluster in the high-wear category, while the low organizational health schools tend to be in the low-wear category. Said simply, schools with high organizational health had low replacement rates and high wearing rates, so perhaps their rates were low because they were able to help their students maintain their glasses and wear them regularly. This was not the case in schools with low ratings of organizational health, where students were not wearing glasses (low usage rates) and the missing glasses were not being replaced (low replacement rates). These schools did not have the capacity to either help students maintain glasses or develop a glasses-wearing culture, nor could they address the problem of missing glasses through using a replacement process.

An organizational health lens begins to illuminate how replacements and glasses wearing works (or does not) in schools. Schools with high levels of organizational health are more likely to develop higher levels of glasses wearing, as well as take advantage of a glasses replacement process for benefit their students when necessary. However, they may be able to maintain glasses wearing in their schools, limiting glasses loss and breakage and decreasing the need for replacement. On the other hand, schools with low ratings of organizational health appear unable to develop a habit of glasses wearing in their students and are less likely to take steps to address the problem, such as through using a process to replace missing glasses.

An interesting point these findings raise is the importance of timing. Future work should explore the role of time in the need for replacements. Is there a particular point at which the need for replacements increases suddenly or is this a gradual increase? That would guide when and how often SVAs should visit schools to encourage them to monitor their own students' glasses use as well as take active steps to remedy the problem.

These findings also illustrate the need for additional staff to continue to visit schools after glasses are dispensed, to support schools to maintain the glasses they were given and ensure that they continue to be used regularly. While some schools, particularly those with high levels of organizational health, may be able to sustain this on their own, many schools will need the additional resources and encouragement.

Limitations

This study has a few limitations to note. First, this is initial, exploratory work. While claims are being made about possible relationships between variables and explanations, this was correlational work. Causal claims cannot be supported. These findings simply illustrate promising avenues for future studies that should utilize more rigorous designs. In the same way, this study had a very small sample size of 28 schools in a single setting. These results cannot be assumed to generalize outside this setting, so future work should also focus on a larger sample and more diverse contexts.

Conclusion

This exploratory study looked at the role of a replacement process in one model of school-based vision services, as well as its relationship to glasses usage and organizational health. The findings, while preliminary, illustrate that some valuable program processes, such as a replacement process, may not be utilized to the degree they are needed by participants. It also illustrated the need to consider school-level factors such as organizational health in studies of school-based vision care. Organizational health ratings were helpful in exploring patterns of glasses use and replacement across schools. Schools with higher organizational health appeared to be having more success with the program, through higher levels of glasses wearing and larger numbers of replacement requests. These findings have important implications because they

illustrate the need for long-term involvement in schools after such services are provided, with special attention paid to school level factors to identify schools that may need additional outside support to take full advantage of such programs. This is especially important because school-based vision programs have the potential to address a significant unmet health need, but only if they are maximizing their utilization in all schools they serve.

Chapter 6: Conclusions

Summary of Studies

The series of studies presented here examined different aspects of implementation of a model of school-based vision care, Vision for Baltimore, which is currently being evaluated in 127 public schools. The ultimate goal of the larger program, as well as these smaller studies, is to ensure that all students needing glasses receive and wear them.

The first study examined whether additional support staff and the use of teacher incentives had an impact on the rate of parent consent form return for a school-based eye care program. Active consent to participate in the program was a barrier to providing services to students in need, thus decreasing the ability of the program to provide vision care to all students with unmet vision needs. Findings suggest that utilizing additional support staff in the form of School Vision Advocates (SVAs), as well as modest teacher group incentives are each effective strategies to increase the number of parent permissions, increasing the number of students utilizing a school-based vision program.

The second study examined whether a school-based model of vision care Vision for Baltimore, would have an impact on the number of students wearing glasses in schools. It also explored the role of fidelity of implementation in program effectiveness. The results of this study provide evidence that school-based vision programs can increase the number of students wearing glasses in schools. The findings also suggest that the length of time that schools have glasses has a negative relationship with glasses use.

The third study explored the use of a glasses replacement process across schools in the Vision for Baltimore model of school-based vision care. The results of this exploratory study suggest that there is wide variation in the degree to which schools utilize a process to replace lost

or broken glasses. While the replacement process appears to be underutilized by schools, the reason for this pattern is unknown. The study also examined the role of school organizational health with glasses replacement and usage rates. Schools with high levels of organizational health appeared more likely to develop higher levels of glasses wearing, and these schools also used the glasses replacement process for the benefit their students as needed. Schools with low ratings of organizational health appeared less likely develop a habit of glasses wearing in their students and were less likely to take steps to address the problem, such as by using a replacement process.

Cross-Cutting Themes

Across these three linked studies of implementation of school-based vision services, a number of themes emerged. These were repeated across studies and illustrate lessons for school-based vision programs as well as other attempts to implement similar programs in schools.

Integration. The first theme to develop across these studies was that school-based vision programs cannot simply be a medical service provided within the setting of a school. Instead they must be fully integrated with the business of the school. That means that school leadership and teachers must be involved in these programs. For example, in the first study that evaluated the use of teacher group incentives and SVAs to increase program participation, it was the involvement of the teachers and other school staff that improved the consent rate return and increased the number of students in the pipeline to receive glasses. In the second study examining use of classes in classrooms, it was truly up to teachers to know who needed to wear glasses, remind and encourage their use, and ensure that a supportive, glasses-wearing culture was maintained. In the third study exploring glasses replacement rates, it was teachers and support staff who needed to follow up with students about their glasses and call for replacements.

Schools with high levels of organizational health were able to build these procedures into their existing structures and processes and provide this for their students.

In each study, the importance of building the school-based vision care model into the school structure and process was evident. Clearly, school staff need to be partners in these school-based vision programs, yet this is not generally how programs are conducted. Pizzi et al. (2015) attempted to address the low rate of follow up for children with identified vision needs by employing a social worker to assist parents and increase the number of students receiving follow-up medical care. This social worker-led intervention was moderately successful, and increased follow-up exam rates from less than 5% to nearly 60%, which leaves large numbers of students without needed vision care. This model linked social workers and parents but did little to engage school instructional staff. Frequently the task of contacting and following-up with parents falls to a school nurse (Clarke et al., 2008; Neville et al., 2015), a process that can also bypass teachers. Teachers do not have medical training, but they have three key, perhaps, decisive advantages. First, they know their children well, and see them every day. Second, they know their students' parents, and the parents are likely to trust them. Third, teachers can easily perceive that vision care is part of their core function, as poor vision may diminish student achievement. While a teacher may not have the background to provide detailed medical services, they may already have a relationship with the parent built on trust that could translate to definite steps taken by parents. It is important to note that some vision problems are too complicated to be addressed within the school setting and would require additional services outside the school. However, teachers could even provide support linking parents with these outside providers to get medical care for these small numbers of students with more serious vision concerns.

In addition to the benefits of already having a relationship with parents and some knowledge of their students' family histories, teachers frequently already have procedures in place that could be used for these programs.

For example, prior to involving teachers directly with teacher group incentives, in many schools the consent return process did not involve teachers. The forms may have been given to teachers to pass out, but were returned to the office, and teachers had no role in the process. Yet teachers are experts at getting signed forms back (i.e. permission slips, report cards, disciplinary letters). Teachers frequently know how to reach parents, even if that pathway is not listed formally on any school record. Teachers have funds of knowledge about how to accomplish such tasks and motivation to do so, yet this may be ignored by outside program providers. Teacher involvement has been recognized as necessary for maintaining glasses at school and monitoring use (Ethan et al., 2010; Kodjebacheva et al., 2014), but teachers must be included as full partners in order to maximize the impact of these programs.

Teacher and school integration is also key to long-term sustainability of such programs. Use of glasses is known to decrease over time (Alvi et al., 2015), yet schools could build in structures to ensure that use of glasses is maintained over time. Again, teachers see students every day and know which should be wearing glasses. They are the logical link among children, parents, and service providers. The need for such programs to be truly collaborative with schools, so that vision care is built into what schools are already doing, is a key goal (Kodjebacheva et al., 2014). These studies have shown that school-based vision programs cannot simply take place in schools; they need to be fully integrated within schools for long-term success.

Implementation. A second key theme to arise from these three studies is the importance of high-quality implementation. While none dispute the key role of implementation in program effectiveness in schools (Durlak & Dupre, 2008; O'Donnell, 2008), these three studies illustrated that this also applies to school-based vision models. These programs must define key components of the model and assess the degree to which they are being delivered. Measuring program implementation is complex and encompasses multiple dimensions (Dane & Schneider, 1998), yet it must be overcome. One cannot assume that a program is being enacted as intended (D. Dobson & Cook, 1980; Dusenbury et al., 2003; Hallfors & Godette, 2002; Rohrbach, Graham, & Hansen, 1993). For example, the replacement rate of the glasses dispensed through Vision for Baltimore was 9%. On its face this is very promising; it appears that 91% of students are retaining their glasses. Yet by examining the replacement rate distribution across schools as well as patterns of glasses use provides a more informative and realistic picture. Many schools are not using the process at all, and based on the glasses usage rates, it is clear that all schools need to have glasses replaced. The intermediary implementation variables must be measured and examined in order to understand how the program is being implemented as well as illustrate areas for improvement. These studies support implementation assessment as a way to understand what is happening in a particular intervention, highlight areas of improvement, and interpret outcomes. Implementation assessment can also contribute to knowledge about how programs work, and how they can be improved, beyond the situations of individual schools.

Continuous improvement. A third theme to emerge from these studies is the benefit of researchers working with program providers to monitor implementation and outcomes throughout the project, making adjustments as needed. The first study is a prime example of this approach. Because the consent rate was being monitored weekly, the team could see that many

of the students the program was designed to help were not participating. That gave the project team an early opportunity to develop and test multiple strategies to solve this problem. By the end of the first year SVA support and teacher group incentives were shown to be effective ways to improve the consent return rate. This was then implemented across all schools in the second cohort, with positive results. Consent rates were higher than the first year, with less time spent in each school collecting forms. This also allowed the research team to work with providers to identify patterns of non-response and propose the next problem area to focus on.

A similar process was seen with the observation data. Based on early results from observations, a school-based monitoring and feedback procedure was developed and piloted with several schools in cohort two. Initial results have been positive, so this will be implemented with all schools in the future.

This process of using data in short cycles to solve problems follows a continuous improvement approach (Park, Hironaka, Carver, & Nordstrum, 2013). While this can be very effective for schools and program implementors (Flumerfelt & Green, 2013; Wilka & Cohen, 2013), researchers bring a unique perspective as well as strong data skills that can be of use. Researchers can work to simplify the process and provide additional capacity to the implementation team. A joint effort between researchers and program providers can result in developing a strong intervention as well as documenting the process in a way that contributes what is known about how such programs can be effectively enacted.

The Role of SVAs and other non-Educators

Across these studies, an important theme to emerge is the importance of additional staff, such as SVAs, in supporting teachers. It is clear that teachers have a number of important assets previously described, such as seeing students daily and relationships with parents. Teachers can

leverage those resources to do things such as remind students to wear their glasses or take responsibility for contacting parents to receive permission for students to receive vision care. Yet teachers in high-poverty schools already have difficult jobs with numerous concerns, so that these additional tasks may be burdensome. This illustrates the importance of outside staff such as SVAs. The role of these additional personnel is to simplify the process, work to embed the tasks into what schools and teachers are already doing, and motivate teachers to continue to support the vision needs of their students.

For example, it is clear that teachers have a role to play in reminding students to wear their glasses regularly. This could be an additional chore for teachers, where they have a list of students that require glasses and they need to routinely prompt them to wear their glasses, and follow-up when students are not wearing them. While the work required to accomplish this is minimal, teachers are overextended as it is, so this may be beyond the capacity of many. However, SVAs can work to create an efficient monitoring system as part of something teachers already do – attendance. The glasses check could be incorporated into the attendance procedure, so that while the teacher calls roll, their attendance sheet already denotes which students require glasses. Students who do not have them on could be prompted during this attendance check, and missing glasses could be noted in that same system. The additional support staff (SVAs) could compile those reports and provide feedback to schools on problem areas for usage, as well as assist with any replacement requests. Once this is part of the attendance routine, it is not a burden for teachers, yet accomplishes a meaningful task for a school-based vision program, namely that students regularly wear their glasses.

SVAs also fulfil an important function in that they can simplify the process and troubleshoot unique issues. In a program like Vision for Baltimore, there are many moving parts

and numerous partners. A teacher may have a question, but not be sure who to ask. Rather than require the teacher to know each of the relevant partners and which is appropriate to ask, the teacher can simply communicate with the SVA, who can then connect with the appropriate person. Teachers do not need to be an expert on the program or vision care, because they have a relationship with a staff member who can get them any support or answers that they need. The SVAs can remove many of the barriers to participating in the program, while also making supporting vision care a positive experience for teachers and students.

Practical Applications

The results of these studies have a number of practical applications for school-based vision programs specifically, and other school-based health initiatives broadly. First, school-based health programs should not simply be medical care provided within school buildings. They should take advantage of the knowledge, relationships, and motivations that educators have, as well as involve educators in the program as full partners. Schools should work with the programs to see how to align its requirements with what is already happening in schools, and plan for how schools can support the long-term impact of these health programs. It is accepted that basic health needs must be addressed before meaningful learning can occur (Maslow, 1943), and such school-based programs are a promising way to address these needs. Yet they must be built into the regular school day and become a routine part of what teachers address. With this perspective, these programs could be transformative for students who otherwise have unmet health needs.

These studies have also illustrated the need for taking a long-term view of these programs. A school-based vision program that visits a school for a week to provide glasses and leaves will not solve the issue of unmet vision needs – it is simply a short-term band-aid. These programs must have a plan that includes not only providing the services, but also includes steps

for maintaining those efforts until the next time services can be provided. Without such plans these become one-time efforts that do not address the systemic gap in vision care access by students, particularly those in disadvantaged contexts.

Conclusion

Seemingly simple interventions, such as providing glasses to students in need, are in fact complex to bring to life and keep going in schools, particularly at scale. Yet understanding how different components of such school-based vision care programs work is worth the effort. Only through deep examination of the implementation of these efforts can school health programs be improved and effectively provide the vision care so many students are lacking. This is of immediate concern, because the widespread nature of vision deficits combined with the high levels of unmet need lead to very large numbers of students who cannot see. This has serious consequences for their lives, and from the view of schools, may be a serious barrier to academic success. However, examining the implementation of school-based vision programs helps these programs to become effective and replicable ways of providing necessary vision services to numerous children.

Appendix

Table 1. Use of Prescribed Glasses in U.S. Studies.

Study	Location	Population	Timeframe	Compliance
Preslan & Novak, 1998	US: Baltimore	preK-1	1 year	30%
Ethan et al., 2010	US: New York City	1-2nd grade	short-term	47%
Alvi et al., 2015	US: Philadelphia	K-8	1 month	85.87%
			12 months	79.78%
Messer et al., 2012	US: Southern Arizona	3-8	10-14 months	33%
Kodjebacheva et al., 2014	US: Southern California	1-2	6 months	73.3%

Table 2. Adherence to Vision Exam.

Study	Adherence	Notes
Mark & Mark, 1999	35% no exam	People who were able to be reached by phone and said they had received the failed screening letter. Failure rate is likely higher
Clarke et al., 2008	17% had plans	Nurse phoned to follow up. These were those that had plans to follow through.
Neville et al., 2015	17% followed up	This was documented follow-up

Table 3. Description of Schools and Baseline Equivalence.

	Full Sample	Cohort 1	Cohort 2	Cohort 3	*p*
Categorical Variables	*N (%)*	*N (%)*	*N (%)*	*N (%)*	
Full Sample	127	42	42	43	
School Type					0.99
Elementary	47 (37.0)	15 (35.7)	16 (38.1)	16 (37.2)	
Elementary/Middle	71 (55.9)	24 (57.1)	23 (54.8)	24 (55.8)	
Middle	9 (7.1)	3 (7.1)	3 (7.1)	3 (7.0)	
Charter Status					0.94
Charter	25 (19.7)	9 (21.4)	8 (19.0)	8 (18.6)	
Not Charter	102 (80.3)	33 (78.6)	34 (81.0)	35 (81.4)	
Continuous Variables		*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	
Enrollment	444.80 (203.64)	451.65 (223.69)	424.48 (161.77)	458.60 (223.55)	0.723
Male	51.11 (8.28)	52.89 (11.14)	50.79 (3.11)	49.69 (8.35)	0.195
African American	82.78 (23.83)	82.38 (21.86)	82.30 (26.32)	83.64 (23.57)	0.96
Hispanic	5.59 (11.72)	6.07 (10.12)	6.10 (14.66)	4.62 (9.91)	0.809
White	9.25 (15.57)	8.69 (13.69)	9.45 (16.99)	9.58 (16.12)	0.963
atbelowL1 ELA	32.33 (13.84)	33.52 (13.03)	32.46 (14.25)	31.08 (14.40)	0.73
atbelowL1 Math	32.16 (12.97)	34.64 (11.71)	31.05 (12.83)	30.90 (14.17)	0.34
atbelowL2 Math	68.64 (15.03)	70.97 (13.97)	68.09 (14.70)	66.98 (16.36)	0.468
atbelowL2 ELA	62.93 (16.43)	64.68 (14.11)	62.58 (17.24)	61.60 (17.85)	0.691
atbelowL3 ELA	85.37 (11.43)	86.60 (9.11)	85.39 (12.08)	84.18 (12.79)	0.634
atbelowL3 Math	89.75 (8.96)	90.86 (7.85)	90.16 (8.38)	88.28 (10.42)	0.402
FARMS	88.15 (13.47)	88.99 (10.29)	89.07 (13.74)	86.43 (15.81)	0.6
LEP	4.17 (10.06)	5.49 (8.92)	4.20 (12.45)	2.88 (8.33)	0.506
SPED	14.32 (4.82)	14.02 (4.34)	14.82 (5.03)	14.11 (5.11)	0.713

Table 4. Descriptive Statistics for Early Consent Rate.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Consent rate (early implementation)	24	0.262	0.207	0.000	0.116	0.261	0.364	0.737

Table 5. Correlations of School Descriptive Variables for Early Consent Rate.

							ELA			Math				
	Early rate	Enrollment	Male	African American	Hispanic	White	atbelowL1	atbelowL2	atbelowL3	atbelowL1	atbelowL2	atbelowL3	FARMS	LEP
Early Rate														
Enrollment	-0.20													
Male	0.27	0.22												
African American	-0.19	0.10	-0.18											
Hispanic	-0.10	0.03	-0.15	-0.60****										
White	0.23	-0.17	0.33*	-0.88****	0.17									
ELA														
atbelowL1	-0.03	0.03	-0.20	0.35*	0.02	-0.45**								
atbelowL2	0.02	-0.04	-0.27	0.43**	0.03	-0.55***	0.93****							
atbelowL3	-0.08	0.01	-0.31	0.44**	0.13	-0.62****	0.83****	0.93****						
Math														
atbelowL1	0.01	0.03	-0.16	0.36*	-0.01	-0.40*	0.80****	0.81****	0.76****					
atbelowL2	0.04	0.07	-0.14	0.47**	-0.06	-0.51***	0.80****	0.84****	0.78****	0.91****				
atbelowL3	-0.03	0.13	-0.14	0.55***	-0.09	-0.57***	0.73****	0.74****	0.72****	0.83****	0.96****			
FARMS	-0.01	0.07	-0.30	0.46**	0.15	-0.67****	0.56***	0.72****	0.84****	0.51***	0.60****	0.57***		
LEP	-0.04	0.15	-0.10	-0.53***	0.92****	0.10	0.09	0.09	0.16	0.00	-0.05	-0.09	0.19	
SPED	0.09	-0.35*	0.07	0.21	-0.36*	-0.03	0.04	-0.05	-0.12	0.13	0.05	0.07	-0.27	-0.41*

Note. *p < .05. **p < .01. ***p < .001. ****p < .0001.

Table 6. Fixed-Effects ANOVA Results Comparing Early Consent Rate Between Charter and Non-Charter Schools.

Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*	$_{partial}\eta^2$	$_{partial}\eta^2$ 90% CI [LL, UL]
(Intercept)	0.16	1	0.16	3.59	.071		
Charter	0.02	1	0.02	0.45	.510	.02	[.00, .18]
Error	0.96	22	0.04				

Note. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively.

Table 7. Fixed-Effects ANOVA results Comparing Early Consent Rate Between Elementary, Elementary/Middle, and Middle Schools.

Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*	$_{partial}\eta^2$	$_{partial}\eta^2$ 90% CI [LL, UL]
(Intercept)	1.14	1	1.14	27.22	.000		
School Type	0.10	2	0.05	1.22	.316	.10	[.00, .27]
Error	0.88	21	0.04				

Note. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively.

Table 8. Description of Schools Participating in Incentives and Non-Participating Schools.

	Full Sample	Non-participating (no incentives)	Participating (incentives)	*p*
Categorical Variables	*N(%)*	*N (%)*	*N (%)*	
Total	41 (100%)[2]	28 (100%)	13 (100%)	
School Type				0.058
Elementary	15 (36.6)	7 (25.0)	8 (61.5)	
Elementary/Middle	23 (56.1)	18 (64.3)	5 (38.5)	
Middle	3 (7.3)	3 (10.7)	0 (0.0)	
Charter Status				0.085
Charter	8 (19.5)	8 (28.6)	0 (0.0)	
Not Charter	33 (80.5)	20 (71.4)	13 (100.0)	
Continuous Variables	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	
Enrollment	444.82 (222.35)	427.81 (253.43)	478.85 (144.44)	0.506
Male	53.03 (11.24)	54.21 (13.33)	50.49 (3.25)	0.329
African American	83.97 (19.67)	83.44 (19.85)	85.02 (20.07)	0.816
Hispanic	5.29 (8.95)	5.86 (10.40)	4.15 (5.13)	0.582
White	8.05 (13.25)	8.63 (13.13)	6.88 (13.94)	0.702
atbelowL1_ELA	34.02 (12.80)	32.16 (10.48)	37.74 (16.36)	0.204
atbelowL1_Math	35.21 (11.29)	35.45 (11.05)	34.73 (12.21)	0.854
atbelowL2_Math	71.56 (13.63)	72.21 (12.36)	70.27 (16.36)	0.68
atbelowL2_ELA	65.42 (13.47)	64.17 (12.62)	67.93 (15.26)	0.42
atbelowL3_ELA	87.14 (8.58)	86.52 (8.13)	88.37 (9.64)	0.531
atbelowL3_Math	91.28 (7.50)	91.86 (5.99)	90.11 (10.05)	0.5
FARMS	89.37 (10.14)	88.59 (10.92)	90.94 (8.56)	0.502
LEP	5.26 (8.91)	4.73 (9.45)	6.32 (7.98)	0.606
Early Consent Rate	0.26 (0.21)	0.29 (0.24)	0.23 (0.16)	0.53

[2] While there were originally 42 schools randomized to sample, 1 school had already been served by the program as a pilot school, so it was dropped from the study.

Table 9. Description of Schools in Different Treatment Groups.

	Group 1 (ABC)	Group 2 (AC)	Group 3 (BC)	*p*
Categorical Variables	*N (%)*	*N (%)*	*N (%)*	
Total Schools	5	3	5	
School Type				<.01
Elementary	2 (40.0)	3 (100.0)	3 (60.0)	
Elementary/Middle	3 (60.0)	0 (0.0)	2 (40.0)	
Middle	0 (0.0)	0 (0.0)	0 (0.0)	
Charter Status				<.01
Charter	0 (0.0)	0 (0.0)	0 (0.0)	
Not Charter	5 (100.0)	3 (100.0)	5 (100.0)	
Continuous Variables	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	
Enrollment	530.80 (182.21)	472.33 (146.09)	430.80 (111.48)	0.589
Male	50.50 (0.93)	48.11 (1.17)	51.89 (4.85)	0.305
African American	89.22 (8.44)	95.47 (5.28)	74.56 (29.70)	0.329
Hispanic	0.46 (0.49)	0.10 (0.17)	0.20 (0.27)	0.372
White	1.12 (1.50)	0.37 (0.64)	5.26 (7.53)	0.317
atbelowL1_ELA	5.80 (7.95)	2.67 (3.67)	3.40 (1.80)	0.685
atbelowL2_ELA	1.20 (2.41)	0.20 (0.35)	0.42 (0.43)	0.626
atbelowL3_ELA	1.98 (1.28)	0.87 (0.90)	15.38 (20.81)	0.232
atbelowL1_Math	0.18 (0.30)	0.27 (0.46)	0.80 (0.68)	0.18
atbelowL2_Math	37.11 (11.04)	49.40 (14.97)	31.37 (20.39)	0.347
atbelowL3_Math	69.80 (11.54)	77.56 (8.78)	60.27 (19.49)	0.306
FARMS	89.89 (5.71)	93.56 (2.08)	83.74 (13.92)	0.373
LEP	35.23 (11.29)	42.60 (7.88)	29.51 (14.41)	0.369

Table 10. Summary of Consent Rates in Different Phases.

School	Baseline (A)	SVA (B)	Incentives (C)	Additive Impact
Group 1				
A	12%	53%	60%	48%
B	29%	41%	63%	34%
C	19%	43%	83%	64%
D	31%	52%	56%	25%
E	15%	46%	82%	67%
Group 2				
F	36%		91%	55%
G	66%		79%	13%
H	26%		49%	23%
Group 3				
I		52%	57%	5%
J		38%	45%	7%
K		66%	73%	7%
L		34%	44%	10%
M		49%	57%	8%
Mean	29.25%	47.40%	64.54%	41.13%
Median	28%	48%	60%	41%
Max	66%	66%	91%	67%
Min	12%	34%	44%	13%

Table 11. Sample Attrition and Missing Data.

	Cohort 1	Cohort 2	Cohort 3
Full Sample at Randomization	42	42 (100%)	43 (100%)
Schools Closed/Other Not Served	1	1	3
No Observation Collected (missing)	NA	5	7
Not Treated by observation	NA	12	NA
Analytic Sample	NA	25*	33

Note. *Categories are not mutually exclusive. One school had both a missing observation and was not treated by the end of the year.

Table 12. Baseline Equivalence of Analytic Sample.

	Treatment (cohort2)	Control (cohort3)	*p*
Categorical Variables	*N (%)*	*N (%)*	
Full Sample	25	33	
School Type			0.939
Elementary	11 (44.0)	14 (42.4)	
Elementary/Middle	13 (52.0)	17 (51.5)	
Middle	1 (4.0)	2 (6.1)	
Charter Status			0.83
Charter	6 (24.0)	6 (18.2)	
Not Charter	19 (76.0)	27 (81.8)	
Continuous Variables	*Mean (SD)*	*Mean (SD)*	
Enrollment	435.96 (177.03)	465.84 (175.29)	0.527
Male	50.80 (3.09)	49.41 (9.41)	0.48
African American	74.44 (30.90)	83.10 (24.52)	0.243
Hispanic	8.88 (18.50)	5.65 (11.19)	0.417
White	13.92 (20.30)	9.29 (16.20)	0.342
atbelowL1_P_ELA	29.87 (13.47)	30.78 (14.26)	0.806
atbelowL1_P_Math	27.86 (12.09)	31.31 (14.46)	0.342
atbelowL2_P_Math	65.07 (14.93)	67.79 (15.86)	0.512
atbelowL2_P_ELA	59.69 (17.30)	61.35 (16.92)	0.717
atbelowL3_P_ELA	83.98 (12.12)	84.35 (10.84)	0.905
atbelowL3_P_Math	88.55 (8.56)	89.00 (8.71)	0.846
FARMS_P	88.08 (14.47)	87.97 (12.98)	0.976
LEP_P	6.43 (15.57)	3.70 (9.41)	0.417
SPED_P	14.24 (4.79)	14.08 (4.89)	0.899

Table 13. Independent Group t-test Comparing Treatment and Control on Glasses Usage Rate.

Condition	N	Mean	SD	t
Treatment	25	0.12	0.04	2.715**
Control	33	0.09	0.04	

Note. **p < .01.

Table 14. Independent Group t-test Comparing Treatment and Control on Glasses Usage Rate in the Lower Elementary Grades.

Condition	N	Mean	SD	t
Treatment	24	0.09	0.05	2.58*
Control	31	0.06	0.02	

Note. *p < .05.

Table 15. Independent Group t-test Comparing Treatment and Control on Glasses Usage Rate in the Upper Elementary Grades.

Condition	N	Mean	SD	t
Treatment	24	0.13	0.06	1.66
Control	31	0.11	0.05	

Table 16. Independent Group t-test Comparing Treatment and Control on Glasses Usage Rate in the Middle Grades.

Condition	N	Mean	SD	t
Treatment	13	0.19	0.05	1.88`
Control	19	0.15	0.07	

Note. `p < .10

Table 17. Descriptive Statistics of Fidelity of Implementation Measures.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Completed (%)	21	0.657	0.193	0.287	0.496	0.663	0.804	0.981
Screened (%)	25	1.009	0.044	0.940	0.977	0.997	1.035	1.131
Consented (%)	25	0.759	0.198	0.410	0.586	0.805	0.965	1.000
Examined (%)	21	0.856	0.099	0.693	0.790	0.843	0.929	1.031
Maintenance (days)	25	102	64	2	41	99	161	190

Note. Mean values are the proportion of students, so that 0.657 = 65.7% of students.

Table 18. The Association of Fidelity and Glasses Use.

	Dependent variable: Glasses Usage Rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Comprehensive Fidelity	0.011 (0.030)					
Screened		0.083 (0.204)				0.053 (0.187)
Consented			0.066 (0.044)			0.064 (0.040)
Examined				-0.020 (0.027)		-0.006 (0.026)
Treatment					-0.0003*** (0.0001)	-0.0003** (0.0001)
Constant	0.118*** (0.019)	0.040 (0.205)	0.074** (0.034)	0.138*** (0.021)	0.159*** (0.015)	0.060 (0.192)
Observations	25	25	25	25	25	25
R^2	0.005	0.007	0.089	0.024	0.257	0.350
Adjusted R^2	-0.038	-0.036	0.049	-0.019	0.225	0.220
Residual Std. Error	0.044 (df = 23)	0.044 (df = 23)	0.042 (df = 23)	0.044 (df = 23)	0.038 (df = 23)	0.038 (df = 20)
F Statistic	0.125 (df = 1; 23)	0.165 (df = 1; 23)	2.241 (df = 1; 23)	0.557 (df = 1; 23)	7.958*** (df = 1; 23)	2.690* (df = 4; 20)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 19. Correlations of Fidelity Measures.

	Completed	**Screened**	**Consented**	**Examined**
Completed				
Screened	0.41			
Consented	0.93****	0.10		
Examined	0.52*	0.28	0.19	
Maintenance	-0.01	0.03	-0.01	0.25

Note. *p < .05. ****p < .0001.

Table 20. Organizational Health Rating Rubric.

	High	Medium	Low
Leadership	Strong leadership – visible and engaged with program	Leadership – visible, but not always engaged with program	Leadership – not present
Personnel	Liaison in place	Liaison in place	No liaison or liaison with minimal support
Communication	Communication pathways exist with teachers, parents, and program	Communication pathways exist with program, but limited communication pathways with teachers and parents	Limited to no communication pathways to either teachers, parents, or program

Table 21. Correlations Between SVA Organizational Health Rating and City Schools Climate Survey Indicators.

	3-category (H/M/L)	2-category(H/L)	Administration	CreativityTheArts	PhysicalEnvironment	LearningClimate	FindingMeaningInWork	FamilyInvolvement	SchoolResources	Safety	SatisfactionWithSchool	Teachers	OverallIndex
3-category (H/M/L)													
2-category(H/L)	0.94****												
Administration	0.52**	0.53**											
CreativityTheArts	0.17	0.14	0.45*										
PhysicalEnvironment	0.35	0.32	0.15	0.12									
LearningClimate	0.49**	0.51**	0.70****	0.18	0.19								
FindingMeaningInWork	0.60***	0.56**	0.57**	0.13	0.30	0.55**							
FamilyInvolvement	0.42*	0.42*	0.80****	0.49**	0.15	0.74****	0.58**						
SchoolResources	0.51**	0.49**	0.80****	0.35	0.23	0.76****	0.61***	0.82****					
Safety	0.39*	0.43*	0.51**	0.16	0.01	0.86****	0.48**	0.64***	0.62***				
SatisfactionWithSchool	0.44*	0.48*	0.53**	0.25	0.09	0.83****	0.34	0.58**	0.43*	0.73****			
Teachers	0.41*	0.39*	0.69****	0.30	0.06	0.83****	0.53**	0.73****	0.62***	0.76****	0.72****		
OverallIndex	0.56**	0.56**	0.80****	0.37	0.32	0.95****	0.64***	0.84****	0.87****	0.82****	0.75****	0.80****	
DistrictOffice	0.06	0.09	0.14	0.29	0.24	-0.03	0.17	0.17	0.26	0.00	-0.32	-0.08	0.12

Note. *p < .05. **p < .01. ***p < .001. ****p < .0001.

Table 22. Correlations Between SVA Organizational Health Rating and Organizational Health Dimensions.

	3-category (H/M/L)	2-category (H/L)	Academic Emphases	Collegial Leadership	Institutional Integrity	Resource Influence
3-category (H/M/L)						
2-category(H/L)	0.94****					
Academic Emphases	0.44*	0.46*				
Collegial Leadership	0.50**	0.50**	0.52**			
Institutional Integrity	0.60***	0.63***	0.61***	0.72****		
Resource Influence	0.61***	0.59***	0.58**	0.71****	0.73****	
Teacher Affiliation	0.46*	0.52**	0.77****	0.77****	0.71****	0.66***

Note. *p < .05. **p < .01. ***p < .001. ****p < .0001.

Table 23. Descriptive Statistics of Participating Schools

Categorical Variables		*N (%)*
Full Sample		28
School Type		
	Elementary	12 (42.9)
	Elementary/Middle	14 (50.0)
	Middle	2 (7.1)
Charter Status		
	Not a Charter	22 (78.6)
	Charter	6 (21.4)
Continuous Variables		*Mean (SD)*
Enrollment		408.57 (154.42)
Male		50.88 (3.40)
African American		77.52 (29.90)
Hispanic		7.29 (16.95)
White		12.53 (19.60)
atbelowL1 ELA		32.07 (12.96)
atbelowL1 Math		29.75 (12.22)
atbelowL2 Math		66.49 (14.73)
atbelowL2 ELA		62.06 (16.79)
atbelowL3 ELA		85.08 (11.66)
atbelowL3 Math		89.11 (8.33)
FARMS		88.48 (13.71)
LEP		5.43 (14.50)
SPED		14.68 (5.13)

Table 24. Detailed Descriptive Statistics of Replacement Rate.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Replace Rate	28	0.096	0.147	0.000	0.000	0.025	0.104	0.557
Usage Rate	24	0.130	0.069	0.037	0.084	0.132	0.155	0.399

Table 25. Replacement Rate Categories Versus Usage Rate Categories.

	High-use	Low-use	Total
High-replace	3	4	7
Low-replace	9	8	17
Total	12	12	24

Table 26. Description of Schools By Organizational Health Rating.

Organizational Health Rating:	High	Low	*p*
Categorical Variables	*N (%)*	*N (%)*	
Full Sample	14	14	
School Type			0.99
Elementary	6 (42.9)	6 (42.9)	
Elementary/Middle	7 (50.0)	7 (50.0)	
Middle	1 (7.1)	1 (7.1)	
Charter Status			
Not a Charter	11 (78.6)	11 (78.6)	0.99
Charter	3 (21.4)	3 (21.4)	
Continuous Variables	*Mean (SD)*	*Mean (SD)*	
Enrollment	434.36 (177.58)	382.79 (128.68)	0.387
Male	50.47 (3.72)	51.28 (3.14)	0.542
African American	65.65 (37.56)	89.39 (11.95)	0.033
Hispanic	12.42 (23.05)	2.16 (2.92)	0.11
White	19.01 (25.07)	6.04 (8.85)	0.079
atbelowL1 ELA	26.12 (11.06)	38.03 (12.26)	0.012
atbelowL1 Math	24.75 (10.46)	34.76 (12.12)	0.027
atbelowL2 Math	60.58 (14.73)	72.40 (12.60)	0.031
atbelowL2 ELA	55.23 (16.05)	68.90 (15.08)	0.028
atbelowL3 ELA	80.93 (12.22)	89.24 (9.79)	0.058
atbelowL3 Math	85.60 (9.00)	92.62 (6.04)	0.023
FARMS	86.11 (17.51)	90.85 (8.48)	0.37
LEP	9.30 (19.64)	1.56 (4.37)	0.162
SPED	14.78 (4.87)	14.59 (5.55)	0.924
Replacement Rate	0.09 (0.10)	0.08 (0.14)	0.855
Usage Rate	0.13 (0.03)	0.10 (0.04)	0.052

Table 27. Replacement Rate Categories Versus Usage Rate Categories by Health Rating.

	High-use	Low-use	Total
High-replace	High OH = 2	High OH = 3	High OH = 5
	Low OH = 1	Low OH = 1	Low OH = 2
Low-replace	High OH = 7	High OH = 2	High OH = 9
	Low OH = 2	Low OH = 6	Low OH = 8
Total	High OH = 9	High OH = 5	High OH = 14
	Low OH = 3	Low OH = 7	Low OH = 10

Note. OH = Organizational Health

Figure 1. Prevalence of Refractive Error Disorders.

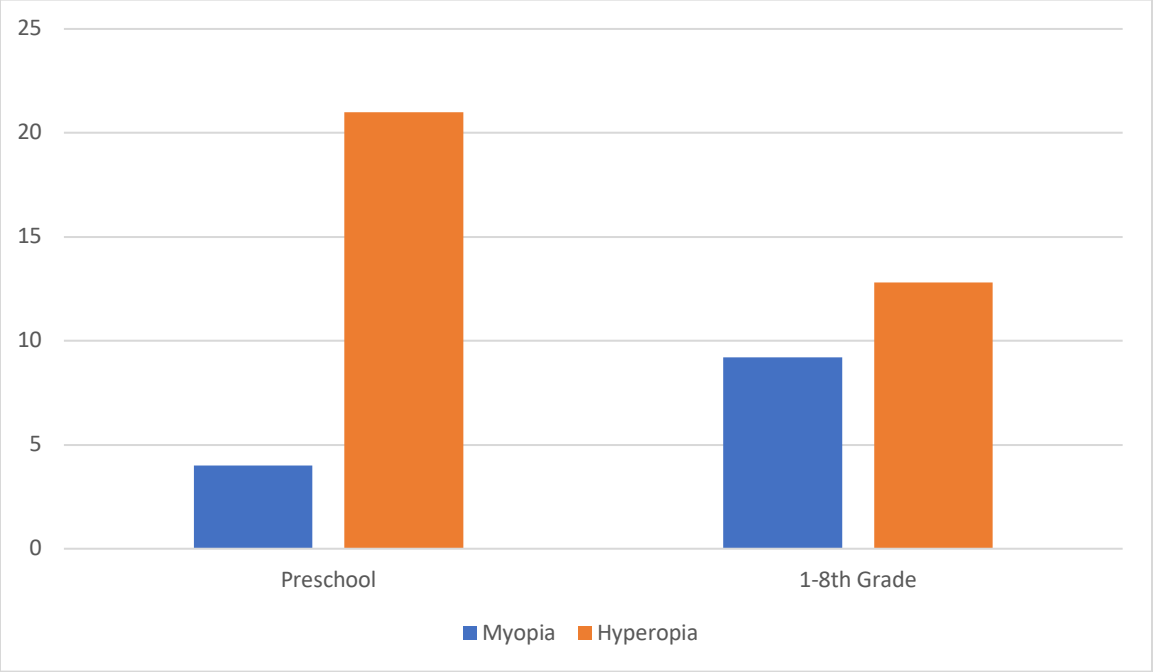


Figure 2. Barriers to Screening Failure Follow-up by Parents.

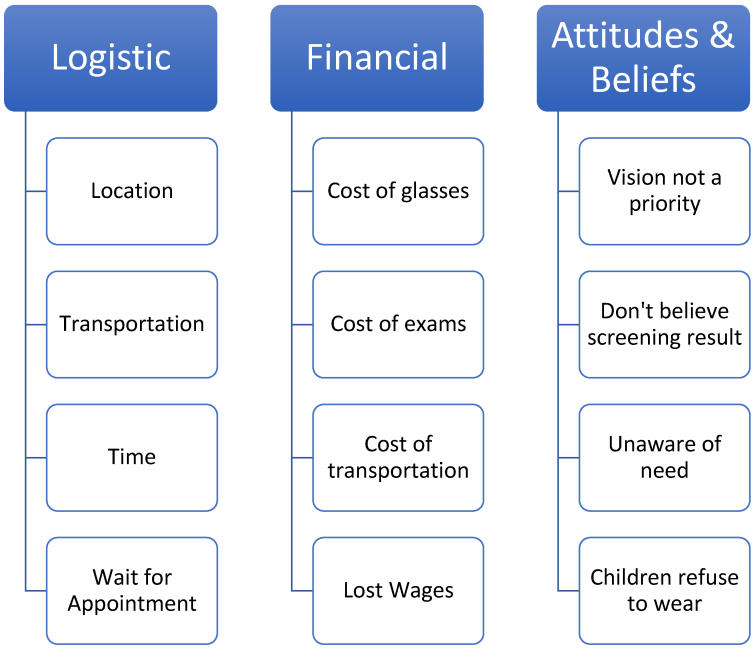
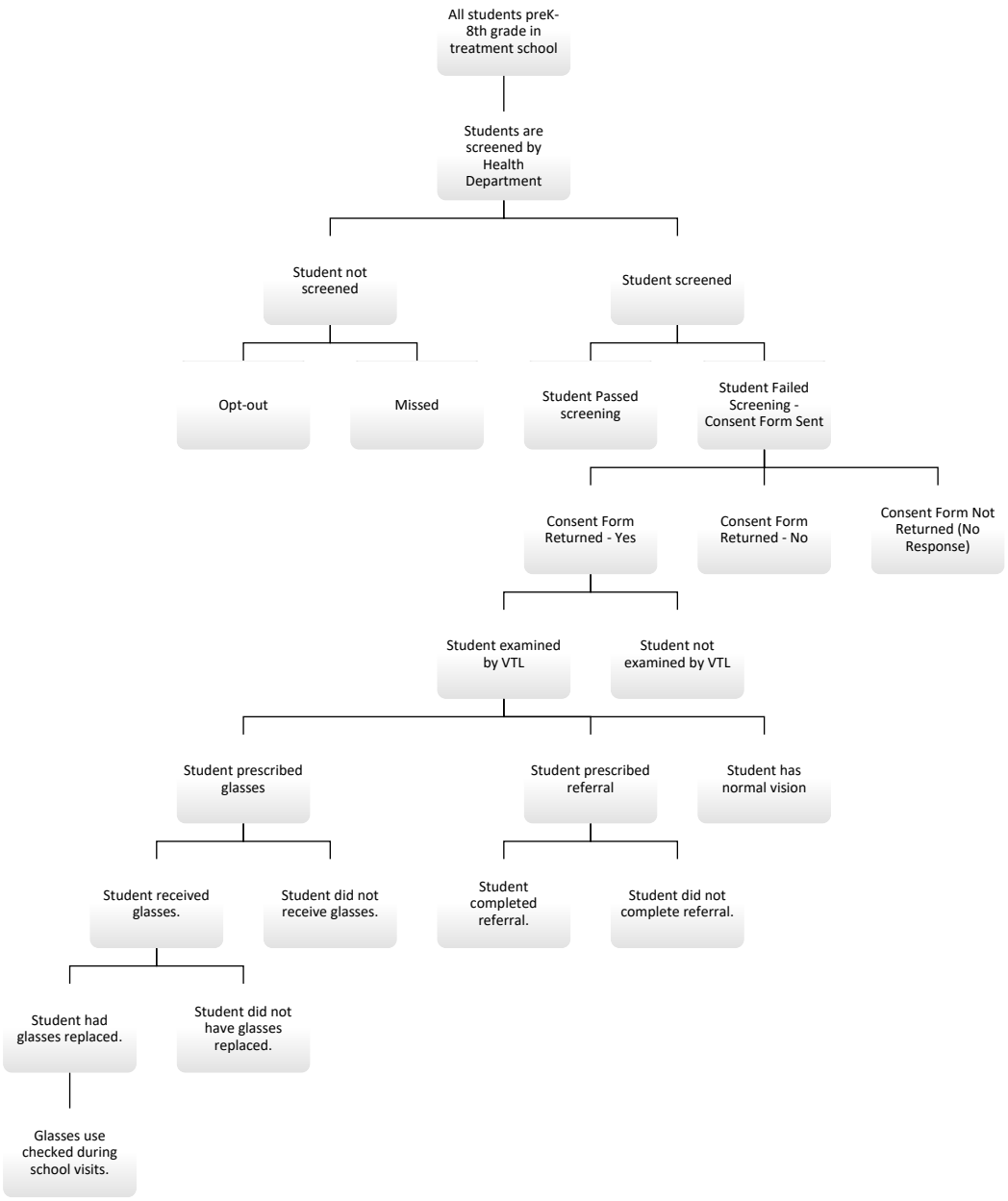


Figure 3. Treatment Overview.



.

Figure 4. Vision for Baltimore Research Design.

Group 1: O-------R ------X ------ O--------- ------O --------- ------O

Group 2: O-------R -------- ------ O-------X ------O --------- ------O

Group 3: O-------R -------- ------ O--------- ------O ------ X ------O

O = Achievement test measurement; R = Randomization; X = Program participation

Figure 5. Pettigrew and Whipp's Model of Strategic Change.

Note. Taken from Pettigrew & Whipp (1992, p. 26).

Figure 6. Consent Rates at Schools During Early Implementation.

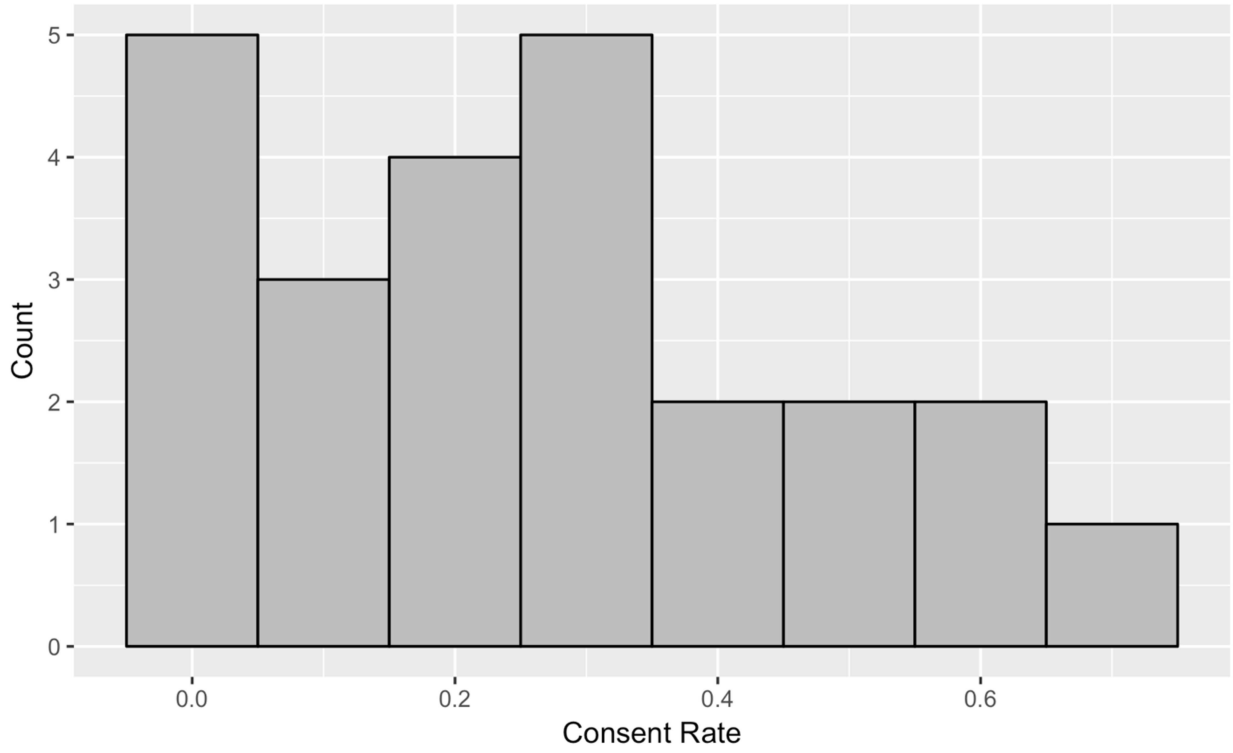


Figure 7. Multiple Baseline Design for Examination of SVAs and Teacher Group Incentives on Consent Rate Return.

Baseline ..... SVA ..... SVA + Group Incentives
O-O-O .....X-X-X.....X-X-X

Note. O = Baseline consent rate measurement; X = Intervention consent rate measurement

Figure 8. Results for Group 1 (ABC) Schools: Baseline -> SVA -> SVA + Group Incentives.

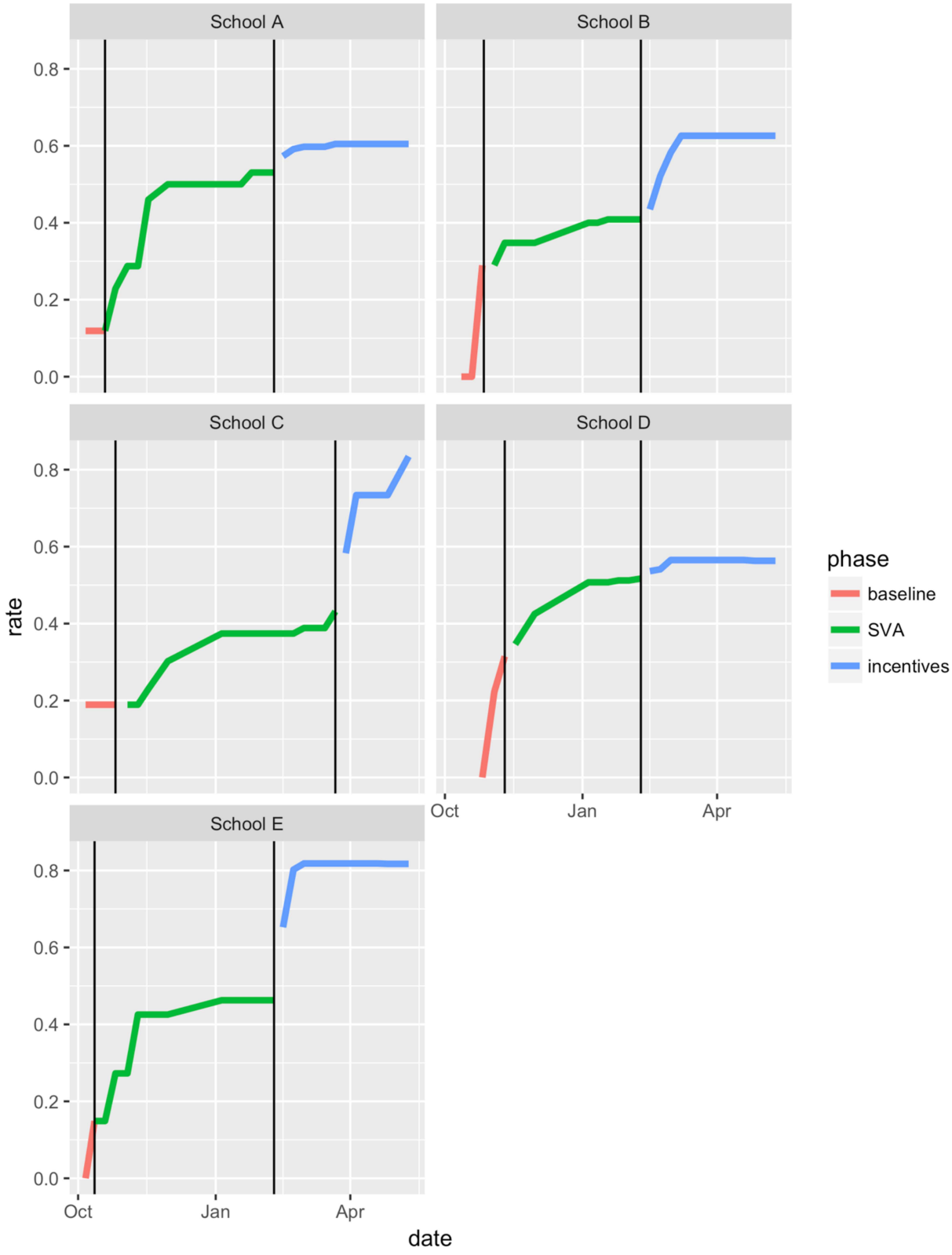


Figure 9. Results for Group 2 (AC) Schools: Baseline -> SVA + Group Incentives.

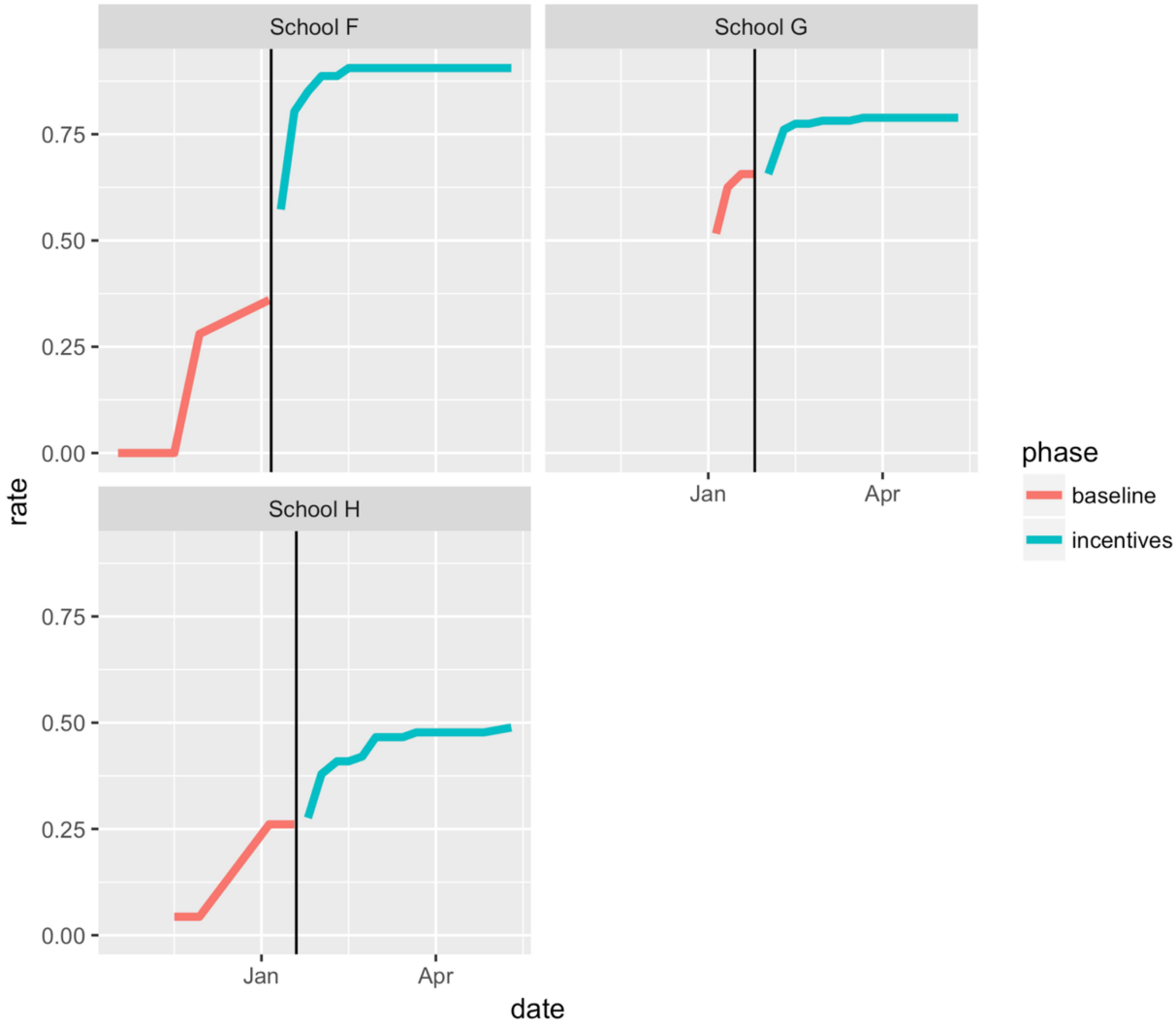


Figure 10. Results for Group 3 (BC) Schools: SVA -> SVA + Group Incentives.

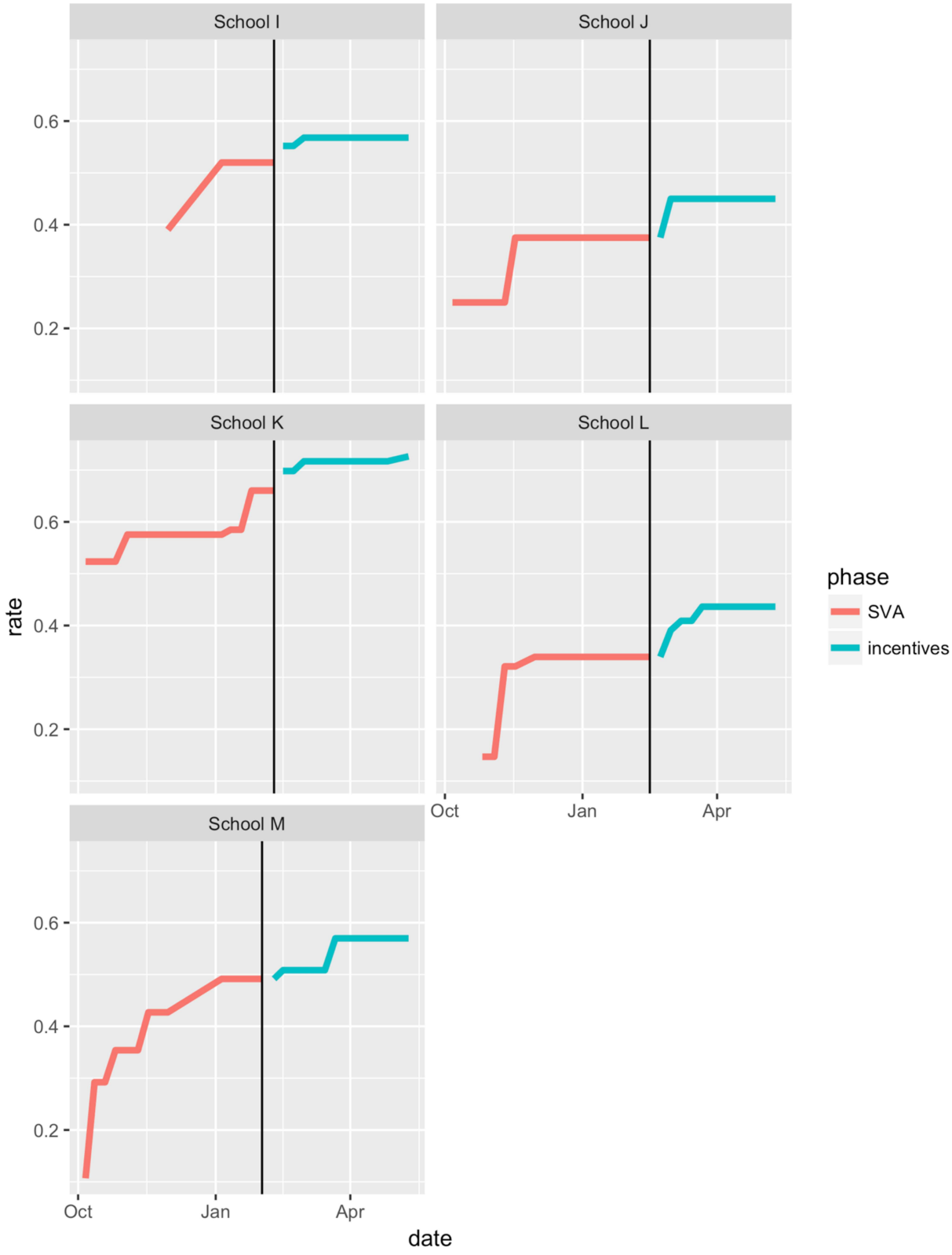


Figure 11. Replacement Rates Across Schools Using Raw Data.

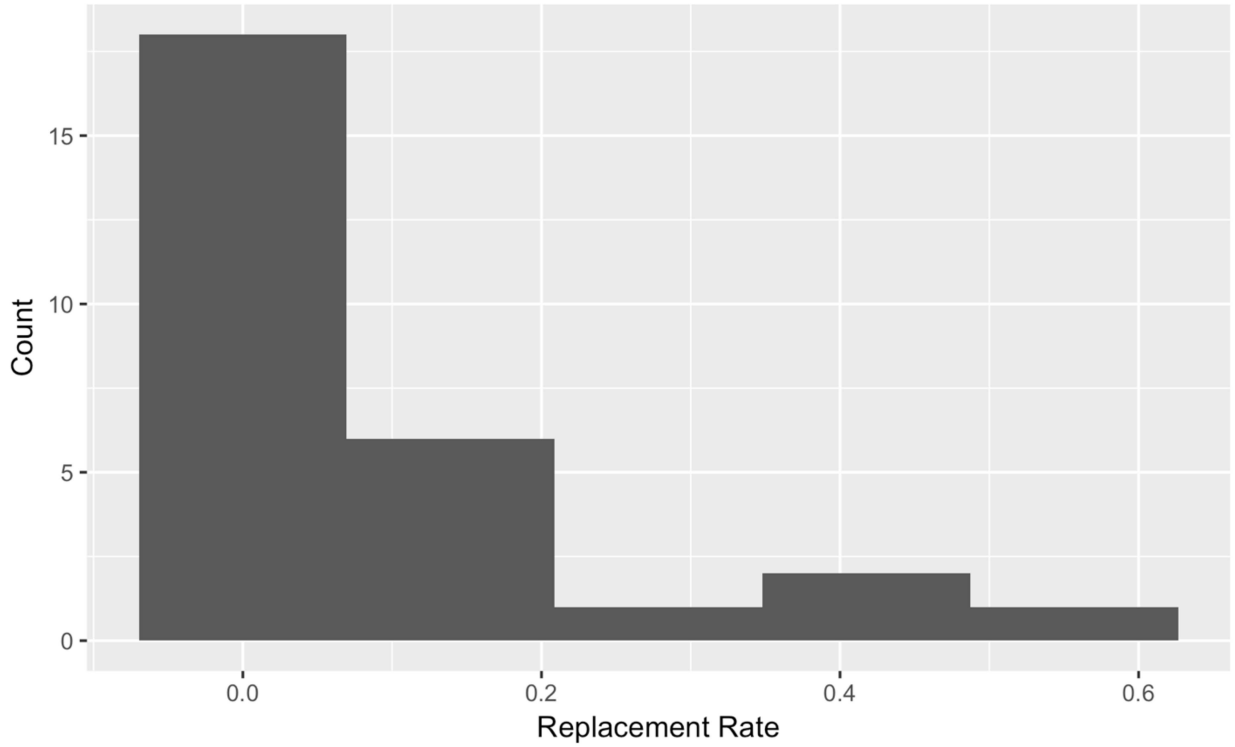


Figure 12. Replacement Rates Across Schools Using Winsorized Data.

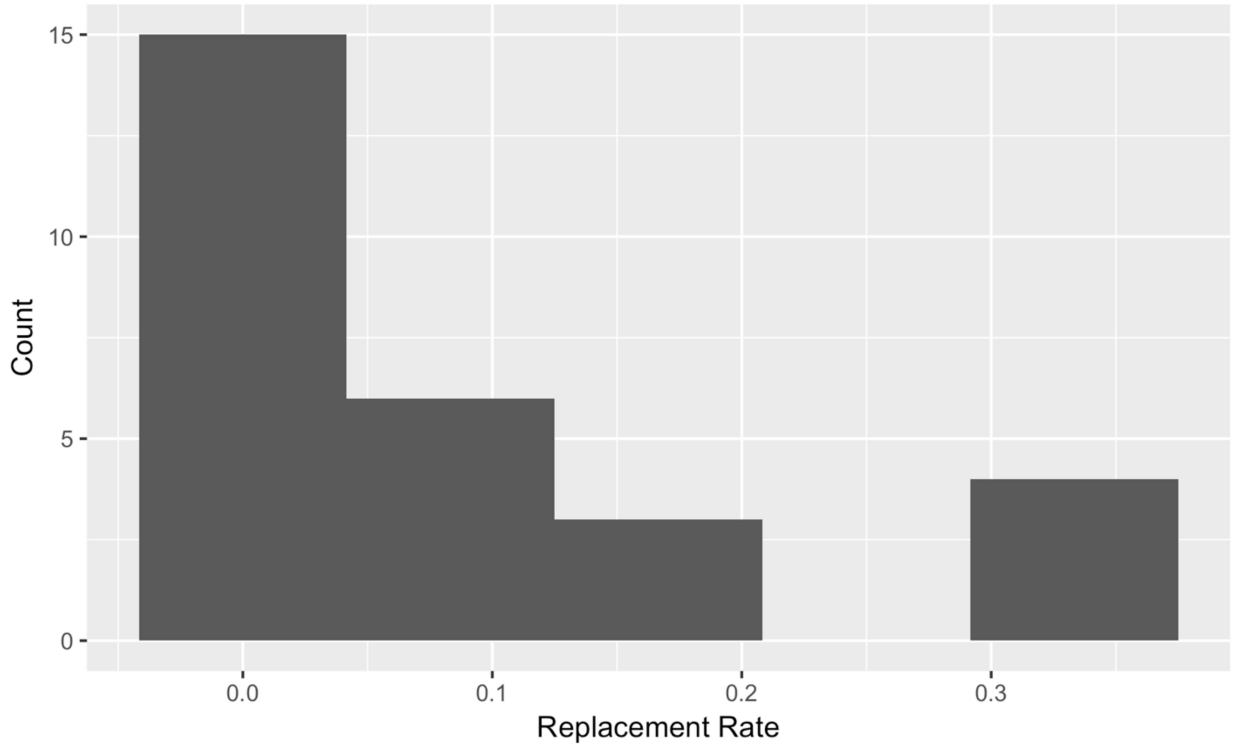


Figure 13. Plot of Replacement Rate Versus Glasses Usage Rate Using Raw Data.

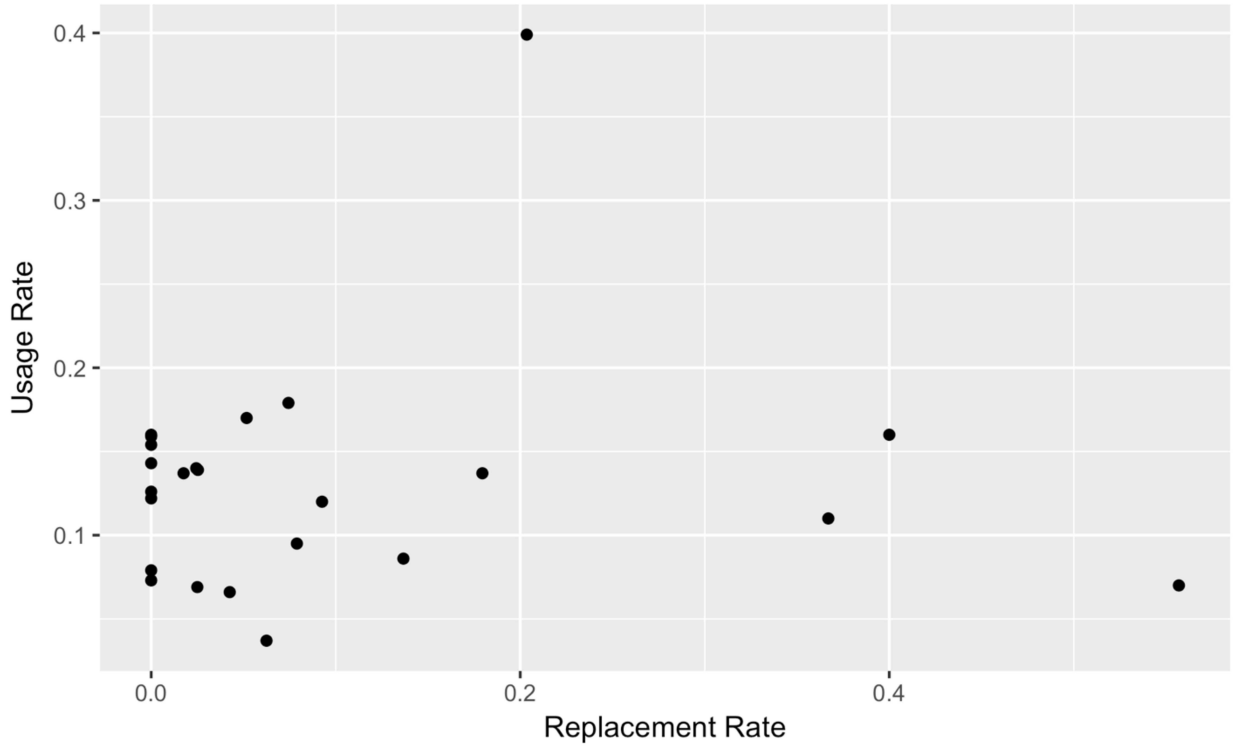


Figure 14. Plot of Replacement Rate Versus Glasses Usage Rate Using Winsorized Data.

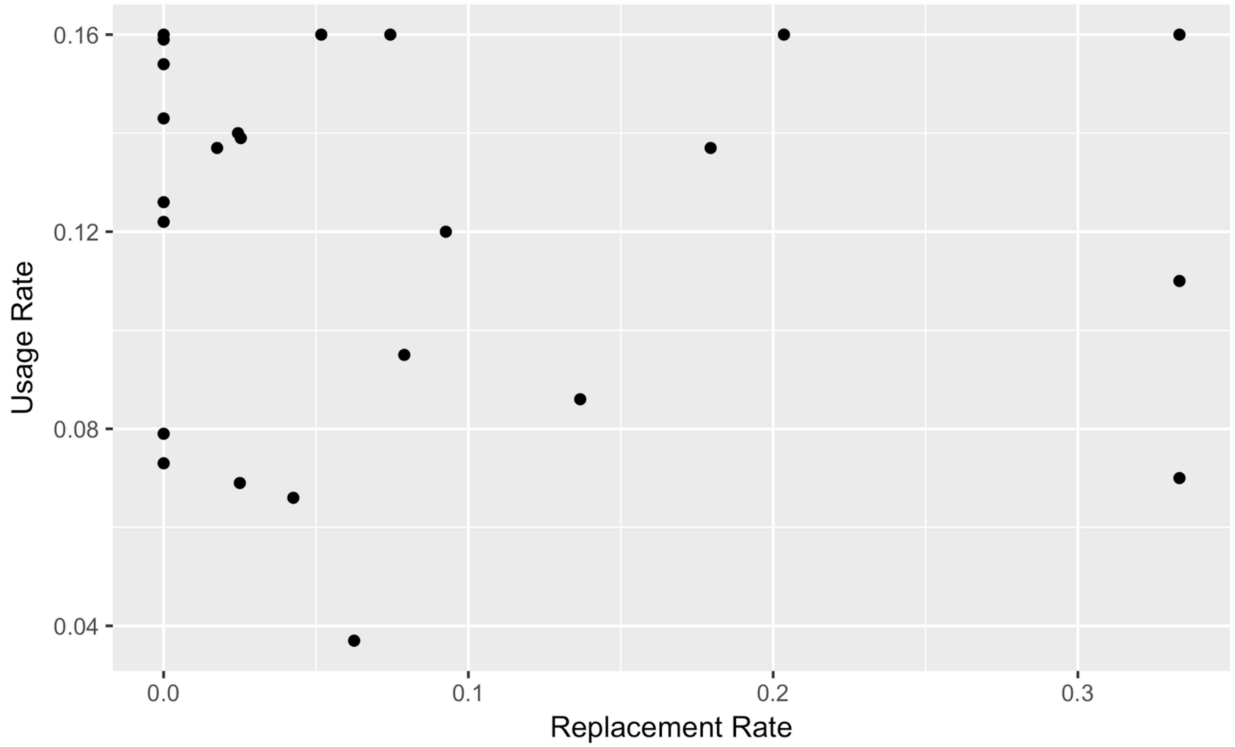
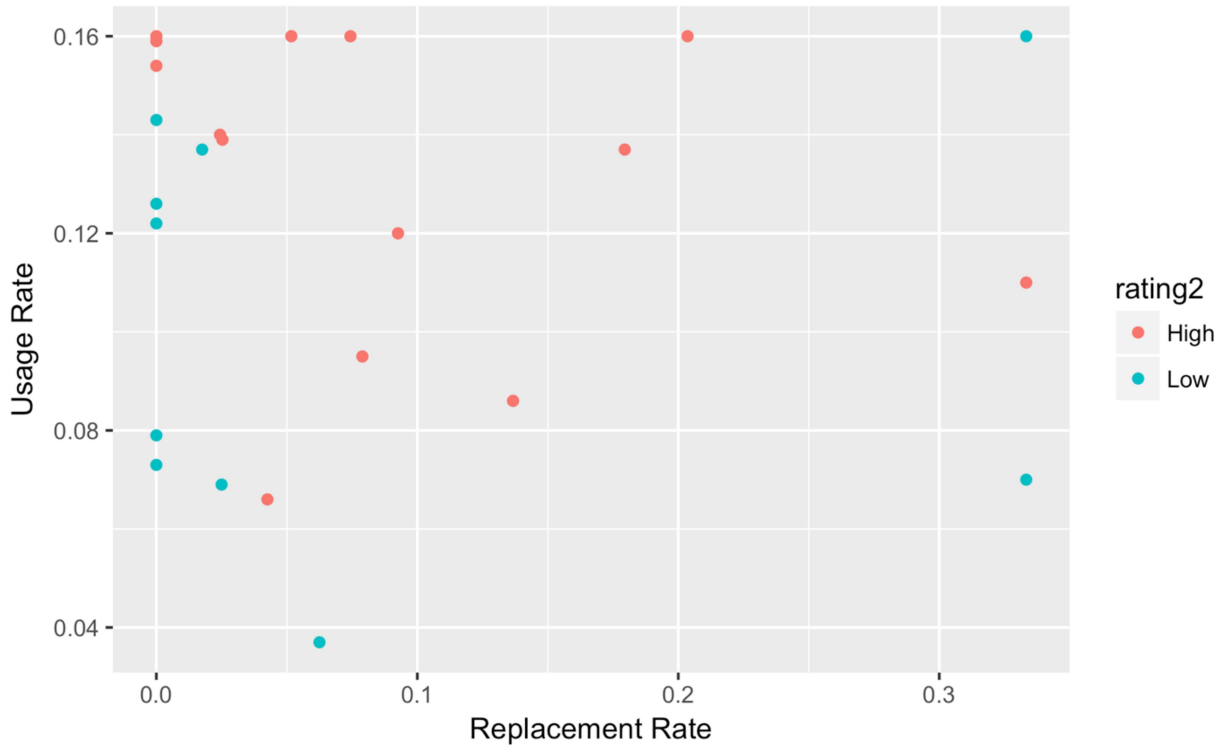


Figure 15. Plot of Replacement Rate Versus Glasses Usage Rate Color-Coded by Organizational Health Rating.



References

Aldebasi, Y. H. (2013). A descriptive study on compliance of spectacle-wear in children of primary schools at Qassim Province, Saudi Arabia. *International Journal of Health Sciences*, *7*(3), 291–299.

Alnahdi, G. H. (2015). Single-subject designs in special education: Advantages and limitations. *Journal of Research in Special Educational Needs*, *15*(4), 257–265. https://doi.org/10.1111/1471-3802.12039

Alvi, R. A., Justason, L., Liotta, C., Martinez-Helfman, S., Dennis, K., Croker, S. P., … Levin, A. V. (2015). The Eagles Eye Mobile: Assessing its ability to deliver eye care in a high-risk community. *Journal of Pediatric Ophthalmology & Strabismus*, *52*(2), 98–105.

Bailey, R. N. (1998). Assessing the predictive ability of the test-positive findings of an elementary school vision screening. *Optometry and Vision Science*, *75*(9), 682–691.

Basch, C. E. (2011). Vision and the achievement gap among urban minority youth. *Journal of School Health*, *81*(10), 599–605.

Berliner, D. C. (2009). *Poverty and potential: Out-of-school factors and school success.* East Lansing, MI: The Great Lakes Center for Education Research & Practice. Retrieved from https://eric.ed.gov/?id=ED507359

Berman, P., & McLaughlin, M. W. (1976). Implementation of educational innovation. *The Educational Forum*, *40*(3), 345–370.

Blom-Hoffman, J., Leff, S. S., Franko, D. L., Weinstein, E., Beakley, K., & Power, T. J. (2009). Consent procedures and participation rates in school-based intervention and prevention research: Using a multi-component, partnership-based approach to recruit participants. *School Mental Health*, *1*(1), 3–15. https://doi.org/10.1007/s12310-008-9000-7

Bodack, M. I., Chung, I., & Krumholtz, I. (2010). An analysis of vision screening data from New York City Public Schools. *Optometry - Journal of the American Optometric Association*, *81*(9), 476–484. https://doi.org/10.1016/j.optm.2010.05.006

Borchert, M. S., Varma, R., Cotter, S. A., Tarczy-Hornoch, K., McKean-Cowdin, R., Lin, J. H., … Giordano, L. (2011). Risk factors for hyperopia and myopia in preschool children. *Ophthalmology*, *118*(10), 1966–1973.

Carpenter, L. R., Lott, J., Lawson, B. M., Hall, S., Craig, A. S., Schaffner, W., & Jones, T. F. (2007). Mass distribution of free, intranasally administered influenza vaccine in a public school system. *PEDIATRICS*, *120*(1), e172–e178.

Carroll, C., Patterson, M., Wood, S., Booth, A., Rick, J., & Balain, S. (2007). A conceptual framework for implementation fidelity. *Implementation Science*, *2*(1), 40.

Castanon Holguin, A. M., Congdon, N., Patel, N., Ratcliffe, A., Esteso, P., Flores, S. T., … Munoz, B. (2006). Factors associated with spectacle-wear compliance in school-aged Mexican children. *Investigative Opthalmology & Visual Science*, *47*(3), 925–928.

Christ, T. J. (2007). Experimental control and threats to internal validity of concurrent and nonconcurrent multiple baseline designs. *Psychology in the Schools*, *44*(5), 451–459.

Chu, R., Huang, K., Barnhardt, C., & Chen, A. (2015). The effect of an on-site vision examination on adherence to vision screening recommendations. *The Journal of School Nursing*, *31*(2), 84–90.

Ciner, E. B., Dobson, V., Schmidt, P. P., Allen, D., Cyert, L., Maguire, M., … Schultz, J. (1999). A survey of vision screening policy of preschool children in the United States. *Survey of Ophthalmology*, *43*(5), 445–457. https://doi.org/10.1016/S0039-6257(99)00021-1

Clabaugh, G. K. (2008). Power failure: Must U.S. school reform miss the mark? *Education Digest*, *73*(5), 59–62.

Clarke, N., Shacks, J., Kerr, A. R. E., Bottrell, C. L., Poulsen, M. K., & Yin, L. (2008). Use of a noncycloplegic autorefractor to perform vision screening in preschools. *The Journal of School Nursing*, *24*(3), 158–163.

Congdon, N., Li, L., Zhang, M., Yang, A., Gao, Y., Griffiths, S., … Lam, D. S. C. (2011). Randomized, controlled trial of an educational intervention to promote spectacle use in rural China: The See Well to Learn Well study. *Ophthalmology*, *118*(12), 2343–2350. https://doi.org/10.1016/j.ophtha.2011.06.016

Congdon, N., Patel, N., Esteso, P., Chikwembani, F., Webber, F., Msithini, R. B., & Ratcliffe, A. (2008). The association between refractive cutoffs for spectacle provision and visual improvement among school-aged children in South Africa. *British Journal of Ophthalmology*, *92*(1), 13–18.

Cotter, S. A., Varma, R., Tarczy-Hornoch, K., McKean-Cowdin, R., Lin, J., Wen, G., … Giordano, L. (2011). Risk factors associated with childhood strabismus. *Ophthalmology*, *118*(11), 2251–2261.

Dane, A. V., & Schneider, B. H. (1998). Program integrity in primary and early secondary prevention: Are implementation effects out of control? *Clinical Psychology Review*, *18*(1), 23–45.

Davidson, S., & Quinn, G. E. (2011). The impact of pediatric vision disorders in adulthood. *Pediatrics*, *127*(2), 334–339. https://doi.org/10.1542/peds.2010-1911

Dobson, D., & Cook, T. J. (1980). Avoiding type III error in program evaluation: Results from a field experiment. *Evaluation and Program Planning*, *3*(4), 269–276.

Dobson, V., Clifford-Donaldson, C. E., Green, T. K., Miller, J. M., & Harvey, E. M. (2009). Optical treatment reduces amblyopia in astigmatic children who receive spectacles before kindergarten. *Ophthalmology*, *116*(5), 1002–1008.

Dudovitz, R. N., Izadpanah, N., Chung, P. J., & Slusser, W. (2016). Parent, teacher, and student perspectives on how corrective lenses improve child wellbeing and school function. *Maternal and Child Health Journal*, *20*(5), 974–983. https://doi.org/10.1007/s10995-015-1882-z

Dudovitz, R. N., Valiente, J. E., Espinosa, G., Yepes, C., Padilla, C., Puffer, M., … Chung, P. J. (2018). A school-based public health model to reduce oral health disparities: A school-based public health model. *Journal of Public Health Dentistry*, *78*(1), 9–16.

Durham, R. E., Bettencourt, A., & Connolly, F. (2014). *Measuring school climate: Using existing data tools on climate and effectiveness to inform school organizational health.* Baltimore, MD: Baltimore Education Research Consortium. Retrieved from http://eric.ed.gov/?id=ED553169

Durlak, J. A., & Dupre, E. P. (2008). Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *American Journal of Community Psychology*, *41*(3–4), 327–350.

Dusenbury, L., Brannigan, R., Falco, M., & Hansen, W. B. (2003). A review of research on fidelity of implementation: Implications for drug abuse prevention in school settings. *Health Education Research*, *18*(2), 237–256.

Ellickson, P. L., & Hawes, J. A. (1989). An assessment of active versus passive methods for obtaining parental consent. *Evaluation Review*, *13*(1), 45–55.

Esbensen, F.-A., Melde, C., Taylor, T. J., & Peterson, D. (2008). Active parental consent in school-based research: How much is enough and how do we get it? *Evaluation Review*, *32*(4), 335–362.

Esbensen, F.-A., Piper Deschenes, E., Vogel, R. E., West, J., Arboit, K., & Harris, L. (1996). Active parental consent in school-based research: An examination of ethical and methodological issues. *Evaluation Review*, *20*(6), 737–753.

Esteso, P., Castanon, A., Toledo, S., Rito, M. A. P., Ervin, A., Wojciechowski, R., & Congdon, N. G. (2007). Correction of moderate myopia Is associated with improvement in self-reported visual functioning among Mexican school-aged children. *Investigative Ophthalmology & Visual Science*, *48*(11), 4949–4954. https://doi.org/10.1167/iovs.07-0052

Ethan, D., & Basch, C. E. (2008). Promoting healthy vision in students: Progress and challenges in policy, programs, and research. *Journal of School Health*, *78*(8), 411–416. https://doi.org/10.1111/j.1746-1561.2008.00323.x

Ethan, D., Basch, C. E., Platt, R., Bogen, E., & Zybert, P. (2010). Implementing and evaluating a school-based program to improve childhood vision. *Journal of School Health*, *80*(7), 340–345.

Ferebee, A. (2004). *Childhood vision: public challenges and opportunities. A policy brief*. Washington, D.C.: Center for Health and Health Care in Schools, School of Public Health, George Washington University Medical Center.

Fletcher, A. C., & Hunter, A. G. (2003). Strategies for obtaining parental consent to participation in research. *Family Relations*, *52*(3), 216–221.

Flumerfelt, S., & Green, G. (2013). Using Lean in the flipped classroom for at risk students. *Journal of Educational Technology & Society*, *16*(1), 356–366.

Gallaway, M. (2010). The need for better school vision screening: The use of VERA vision screening in a community setting. *Optometry and Vision Development*, *41*(4), 232–239.

Ganz, M., Xuan, Z., & Hunter, D. G. (2007). Patterns of eye care use and expenditures among children with diagnosed eye conditions. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, *11*(5), 480–487.

Gogate, P., Mukhopadhyaya, D., Mahadik, A., Naduvilath, T., Sane, S., Shinde, A., & Holden, B. (2013). Spectacle compliance amongst rural secondary school children in Pune district, India. *Indian Journal of Ophthalmology*, *61*(1), 8–12.

Gould, M. C., & Gould, H. (2003). A clear vision for equity and opportunity. *Phi Delta Kappan*, *85*(4), 324–328. https://doi.org/10.1177/003172170308500416

Hallfors, D., & Godette, D. (2002). Will the `Principles of Effectiveness' improve prevention practice? Early findings from a diffusion study. *Health Education Research*, *17*(4), 461–470.

Hannum, E., & Zhang, Y. (2012). Poverty and proximate barriers to learning: Vision deficiencies, vision correction and educational outcomes in rural northwest China. *World Development*, *40*(9), 1921–1931.

Harvey, E. M., Dobson, V., Clifford-Donaldson, C. E., & Miller, J. M. (2007). Optical treatment of amblyopia in astigmatic children. *Ophthalmology*, *114*(12), 2293–2301.

Heslin, K. C., Casey, R., Shaheen, M. A., Cardenas, F., & Baker, R. S. (2006). Racial and ethnic differences in unmet need for vision care among children with special health care needs. *Archives of Ophthalmology*, *124*(6), 895–902.

Hollmann, C. M., & McNamara, J. R. (1999). Considerations in the use of active and passive parental consent procedures. *The Journal of Psychology*, *133*(2), 141–156.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, *71*(2), 165–179. https://doi.org/10.1177/001440290507100203

Horwood, A. M. (1998). Compliance with first time spectacle wear in children under eight years of age. *Eye*, *12*, 173–178.

Hoy, W. K., & Feldman, J. A. (1987). Organizational health: The concept and its measure. *Journal of Research and Development in Education*, *20*(4), 30–37.

Huang, J., Maguire, M., Ciner, E., Kulp, M. T., Cyert, L., Quinn, G. E., … Ying, G.-S. (2014). Risk factors for astigmatism in the Vision in Preschoolers Study. *Optometry & Vision Science*, *91*(5), 514–521.

Huitema, B. E. (2011). *The analysis of covariance and alternatives: Statistical methods for experiments, quasi-experiments, and single-case studies* (2nd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Hussein, M. A., Weakley, D., Wirazka, T., & Paysse, E. E. (2015). The long-term outcomes in children who are not compliant with spectacle treatment for accommodative esotropia. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, *19*(2), 169–171.

Ji, P. Y., Flay, B. R., DuBois, D. L., Brechling, V., Day, J., & Cantillon, D. (2006). Consent form return rates for third-grade urban elementary students. *American Journal of Health Behavior*, *30*(5), 467–474.

Ji, P. Y., Pokorny, S. B., & Jason, L. A. (2004). Factors influencing middle and high schools' active parental consent return rates. *Evaluation Review*, *28*(6), 578–591.

Keay, L., Zeng, Y., Munoz, B., He, M., & Friedman, D. S. (2010). Predictors of early acceptance of free spectacles provided to junior high school students in China. *ARCH OPHTHALMOL*, *128*(10), 1328–1334.

Kemper, A. R., Cohn, L. M., & Dombkowski, K. J. (2004). Patterns of vision care among Medicaid-enrolled children. *Pediatrics*, *113*(3), e190–e196.

Kimel, L. S. (2006). Lack of follow-up exams after failed school vision screenings: An investigation of contributing factors. *The Journal of School Nursing*, *22*(3), 156–162.

Kleinstein, R. N., Jones, L. A., Hullett, S., Kwon, S., Lee, R. J., Friedman, N. E., … Zadnik, K. (2003). Refractive error and ethnicity in children. *Archives of Ophthalmology*, *121*(8), 1141–1147.

Kodjebacheva, G., Maliski, S., & Coleman, A. L. (2015). Use of eyeglasses among children in elementary school: Perceptions, behaviors, and interventions discussed by parents, school nurses, and teachers during focus groups. *American Journal of Health Promotion*, *29*(5), 324–331.

Kodjebacheva, G., Maliski, S., Yu, F., Oelrich, F., & Coleman, A. L. (2014). Decreasing uncorrected refractive error in the classroom through a multifactorial pilot intervention. *The Journal of School Nursing*, *30*(1), 24–30.

Krumholtz, I. (2004). Educating the educators: increasing grade-school teachers' ability to detect vision problems. *Optometry - Journal of the American Optometric Association*, *75*(7), 445–451.

Lambert, R., Gallagher, P. A., & Abbott-Shim, M. (2015). An evaluation of the intensity of mentoring: child outcomes. *Early Child Development and Care*, *185*(8), 1314–1330.

Lanovaz, M. J., & Rapp, J. T. (2016). Using single-case experiments to support evidence-based decisions: How much is enough? *Behavior Modification*, *40*(3), 377–395. https://doi.org/10.1177/0145445515613584

Leakey, T., Lunde, K. B., Koga, K., & Glanz, K. (2004). Written parental consent and the use of incentives in a youth smoking prevention trial: a case study from project SPLASH. *American Journal of Evaluation*, *25*(4), 509–523.

Li, L., Lam, J., Lu, Y., Ye, Y., Lam, D. S., Gao, Y., … Congdon, N. (2010). Attitudes of students, parents, and teachers toward glasses use in rural China. *Archives of Ophthalmology*, *128*(6), 759–765.

Lin, H., Chen, W., Luo, L., Congdon, N., Zhang, X., Zhong, X., … Liu, Y. (2012). Effectiveness of a short message reminder in increasing compliance with pediatric cataract treatment. *Ophthalmology*, *119*(12), 2463–2470.

Ma, X., Congdon, N., Yi, H., Zhou, Z., Pang, X., Meltzer, M. E., … Rozelle, S. (2015). Safety of spectacles for children's vision: A cluster-randomized controlled trial. *American Journal of Ophthalmology*, *160*(5), 897–904. https://doi.org/10.1016/j.ajo.2015.08.013

Ma, X., Zhou, Z., Yi, H., Pang, X., Shi, Y., Chen, Q., … Congdon, N. (2014). Effect of providing free glasses on children's educational outcomes in China: cluster randomized controlled trial. *BMJ*, *349*(sep23 7), g5740–g5740. https://doi.org/10.1136/bmj.g5740

Majeed, M., Williams, C., Northstone, K., & Ben-Shlomo, Y. (2008). Are there inequities in the utilisation of childhood eye-care services in relation to socio-economic status? Evidence

from the ALSPAC cohort. *British Journal of Ophthalmology*, *92*(7), 965–969. https://doi.org/10.1136/bjo.2007.134841

Mak, D. B., Bulsara, M., Goggin, L. S., & Effler, P. V. (2011). Resending a consent form and information package to non-responders increases school-based consent return rate. *Australian and New Zealand Journal of Public Health*, *35*(1), 89–90.

Mark, H., & Mark, T. (1999). Parental reasons for non-response following a referral in school vision screening. *Journal of School Health*, *69*(1), 35–38.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370–396.

McFarland, J., Hussar, B., de Brey, C., Snyder, T., Wang, X., Wilkinson-Flicker, S., … Hinz, S. (2017). *The Condition of Education 2017* (No. NCES 2017-144). Washington D.C.: National Center for Education Statistics.

McKean-Cowdin, R., Varma, R., Cotter, S. A., Tarczy-Hornoch, K., Borchert, M. S., Lin, J. H., … Giordano, L. (2011). Risk factors for astigmatism in preschool children. *Ophthalmology*, *118*(10), 1974–1981.

Messer, D. H., Mitchell, G. L., Twelker, J. D., Crescioni, M., Group, C. S., & others. (2012). Spectacle wear in children given spectacles through a school-based program. *Optometry and Vision Science: Official Publication of the American Academy of Optometry*, *89*(1), 19–26.

Multi-Ethnic Pediatric Eye Disease Study (MEPEDS) Group. (2009). Prevalence and causes of visual impairment in African-American and Hispanic preschool children: The Multi-Ethnic pediatric Eye Disease Study. *Ophthalmology*, *116*(10), 1990-2000.e1.

National Center for Education Statistics. (2015). *National Assessment of Educational Progress*. Washington, D.C.: Author.

National Survey of Children's Health. (n.d.). NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved from www.childhealthdata.org

Neville, K., Radii, E., & Velmer, G. (2015). Improving parental adherence to a failed vision screening referral in the United States. *British Journal of School Nursing*, *10*(3), 135–143.

Odedra, N., Wedner, S. H., Shigongo, Z. S., Nyalali, K., & Gilbert, C. (2008). Barriers to spectacle use in Tanzanian secondary school students. *Ophthalmic Epidemiology*, *15*(6), 410–417.

O'Donnell, C. L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K-12 curriculum intervention research. *Review of Educational Research*, *78*(1), 33–84.

Park, S., Hironaka, S., Carver, P., & Nordstrum, L. (2013). *Continuous improvement in education. Advancing teaching–improving learning. White paper.* Carnegie Foundation for the Advancement of Teaching. Retrieved from https://eric.ed.gov/?id=ED560145

Pavithra, M., Hamsa, L., & Madhukumar, S. (2014). Factors associated with spectacle-wear compliance among school children of 7-15 years in South India. *International Journal of Medicine and Public Health*, *4*(2), 146.

Pettigrew, A., & Whipp, R. (1992). *Managing change for competitive success*. Oxford, UK: Blackwell Publishers Ltd.

Pizzi, L. T., Snitzer, M., Amos, T., Prioli, K. M., Steele, D., & Levin, A. V. (2015). Cost and effectiveness of an eye care adherence program for Philadelphia children with significant visual impairment. *Population Health Management*, *18*(3), 223–231.

Porowski, A., & Passa, A. (2011). The effect of Communities In Schools on high school dropout and graduation rates: Results from a multiyear, school-level quasi-experimental study. *Journal of Education for Students Placed at Risk*, *16*(1), 24–37.

Preslan, M. W., & Novak, A. (1998). Baltimore Vision Screening Project: Phase 2. *Ophthalmology*, *105*, 150–153.

Qiu, M., Wang, S. Y., Singh, K., & Lin, S. C. (2014). Racial disparities in uncorrected and undercorrected refractive error in the United States. *Investigative Ophthalmology & Visual Science*, *55*(10), 6996–7005.

Rohrbach, L. A., Graham, J. W., & Hansen, W. B. (1993). Diffusion of a school-based substance abuse prevention program: predictors of program implementation. *Preventive Medicine*, *22*(2), 237–260. https://doi.org/10.1006/pmed.1993.1020

Ruderman, M. (2016). *Children's vision and eye health: A snapshot of current national issues* (No. 1st ed.). Chicago, IL: National Center for Children's Vision and Eye Health at Prevent Blindness.

Rustagi, N., Taneja, D., & Uppal, Y. (2012). Screening for visual impairment: Outcome among schoolchildren in a rural area of Delhi. *Indian Journal of Ophthalmology*, *60*(3), 203–206.

Slavin, R. E., Collins, M. E., Repka, M. X., Friedman, D. S., Mudie, L. I., Owoeye, J. O., & Madden, N. A. (in press). In plain sight: Reading outcomes of providing eyeglasses to disadvantaged children. *Journal of Education for Students Placed at Risk*.

Stambolian, D. (2013). Genetic susceptibility and mechanisms for refractive error: Genetic susceptibility and mechanisms for refractive error. *Clinical Genetics*, *84*(2), 102–108. https://doi.org/10.1111/cge.12180

Strawhacker, M. T., Gustafson, J. K., Kinne, M. J., & Little, D. (2003). Vision screening practices in central Iowa: A follow-up evaluation. *The Journal of School Nursing*, *19*(2), 111–118.

Su, Z., Marvin, E. K., Wang, B. Q., van Zyl, T., Elia, M. D., Garza, E. N., … Forster, S. H. (2013). Identifying barriers to follow-up eye care for children after failed vision screening in a primary care setting. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, *17*(4), 385–390. https://doi.org/10.1016/j.jaapos.2013.05.008

Tarczy-Hornoch, K., Varma, R., Cotter, S. A., McKean-Cowdin, R., Lin, J. H., Borchert, M. S., … Giordano, L. (2011). Risk factors for decreased visual acuity in preschool children. *Ophthalmology*, *118*(11), 2262–2273. https://doi.org/10.1016/j.ophtha.2011.06.033

Thompson, T. L. (1984). A comparison of methods of increasing parental consent rates in social research. *Public Opinion Quarterly*, *48*(4), 779–787.

Thurston, A. (2014). The potential impact of undiagnosed vision impairment on reading development in the early years of school. *International Journal of Disability, Development and Education*, *61*(2), 152–164. https://doi.org/10.1080/1034912X.2014.905060

Unti, L. M., Coyle, K. K., Woodruff, B. A., & Boyer-Chuanroong, L. (1997). Incentives and motivators in school-based Hepatitis B vaccination programs. *The Journal of School Health*, *67*(7), 265–268.

Vitale, S., Cotch, M., & Sperduto, R. D. (2006). Prevalence of visual impairment in the United States. *JAMA*, *295*(18), 2158–2163.

von-Bischhoffshausen, F. B., Muñoz, B., Riquelme, A., Ormeño, M. J., & Silva, J. C. (2014). Spectacle-wear compliance in school children in Concepción Chile. *Ophthalmic Epidemiology*, *21*(6), 362–369.

Wallace, D. K., Chandler, D. L., Beck, R. W., Arnold, R. W., Bacal, D. A., Birch, E. E., … Tamkins, S. (2007). Treatment of bilateral refractive amblyopia in children three to less than 10 years of age. *American Journal of Ophthalmology*, *144*(4), 487–496.

Watson, P. J., & Workman, E. A. (1981). The non-concurrent multiple baseline across-individuals design: An extension of the traditional multiple baseline design. *Journal of Behavior Therapy and Experimental Psychiatry*, *12*(3), 257–259.

Weiner, B. J., Lewis, M. A., & Linnan, L. A. (2009). Using organization theory to understand the determinants of effective implementation of worksite health promotion programs. *Health Education Research*, *24*(2), 292–305.

What Works Clearinghouse. (2017). *Standards Handbook (Version 4.0)*. Washington, D.C.: Institute of Education Sciences, US Department of Education.

Wilka, M., & Cohen, J. (2013). *It's not just about the model: Blended learning, innovation, and year 2 at Summit Public Schools*. San Francisco, CA: FSG. Retrieved from https://www.issuelab.org/resources/15885/15885.pdf

Williams, W. R. (2005). Hyperopia and educational attainment in a primary school cohort. *Archives of Disease in Childhood*, *90*(2), 150–153. https://doi.org/10.1136/adc.2003.046755

Wolfenden, L., Kypri, K., Freund, M., & Hodder, R. (2009). Obtaining active parental consent for school-based research: A guide for researchers. *Australian and New Zealand Journal of Public Health*, *33*(3), 270–275. https://doi.org/10.1111/j.1753-6405.2009.00387.x

Yawn, B. P., Kurland, M., Butterfield, L., & Johnson, B. (1998). Barriers to seeking care following school vision screening in Rochester, Minnesota. *The Journal of School Health*, *68*(8), 319–324.

Yawn, B. P., Lydick, E. G., Epstein, R., & Jacobsen, S. J. (1996). Is school vision screening effective? *The Journal of School Health*, *66*(5), 171–175.

Yi, H., Zhang, H., Ma, X., Zhang, L., Wang, X., Jin, L., … Congdon, N. (2015). Impact of free glasses and a teacher incentive on children's use of eyeglasses: A cluster-randomized controlled trial. *American Journal of Ophthalmology*, *160*(5), 889–896.

Ying, G., Maguire, M. G., Cyert, L. A., Ciner, E., Quinn, G. E., Kulp, M. T., … Moore, B. (2014). Prevalence of vision disorders by racial and ethnic group among children participating in Head Start. *Ophthalmology*, *121*(3), 630–636. https://doi.org/10.1016/j.ophtha.2013.09.036

Young, T. L. (2007). Complex trait genetics of refractive error. *Archives of Ophthalmology*, *125*(1), 38–48. https://doi.org/10.1001/archopht.125.1.38

Zeng, Y., Keay, L., He, M., Mai, J., Munoz, B., Brady, C., & Friedman, D. S. (2009). A randomized, clinical trial evaluating ready-made and custom spectacles delivered via a school-based screening program in China. *Ophthalmology*, *116*(10), 1839–1845.

Zhang, X., Elliott, M. N., Saaddine, J. B., Berry, J. G., Cuccaro, P., Tortolero, S., … Schuster, M. A. (2012). Unmet eye care needs among U.S. 5th-grade students. *American Journal of Preventive Medicine*, *43*(1), 55–58.

Biography

Amanda J. Inns was born in 1982 in the River Falls, Wisconsin.

Amanda did her undergraduate work at Northwestern University, where she received a Bachelor of Arts in Psychology and International Studies. As an undergraduate, she spent a year at University of Tübingen, Germany studying Psychology. She served as a Peace Corps Volunteer from 2005-2007, working with schools in rural South Africa. She received a Master of Education in Elementary Education from Peabody College of Vanderbilt University in 2009. After teaching in public elementary schools, she began her doctoral studies at Johns Hopkins University in 2014. She has worked on the Vision for Baltimore and Vision for Chicago projects, as well as working on systematic reviews for the Best Evidence Encyclopedia and the Evidence for ESSA website.